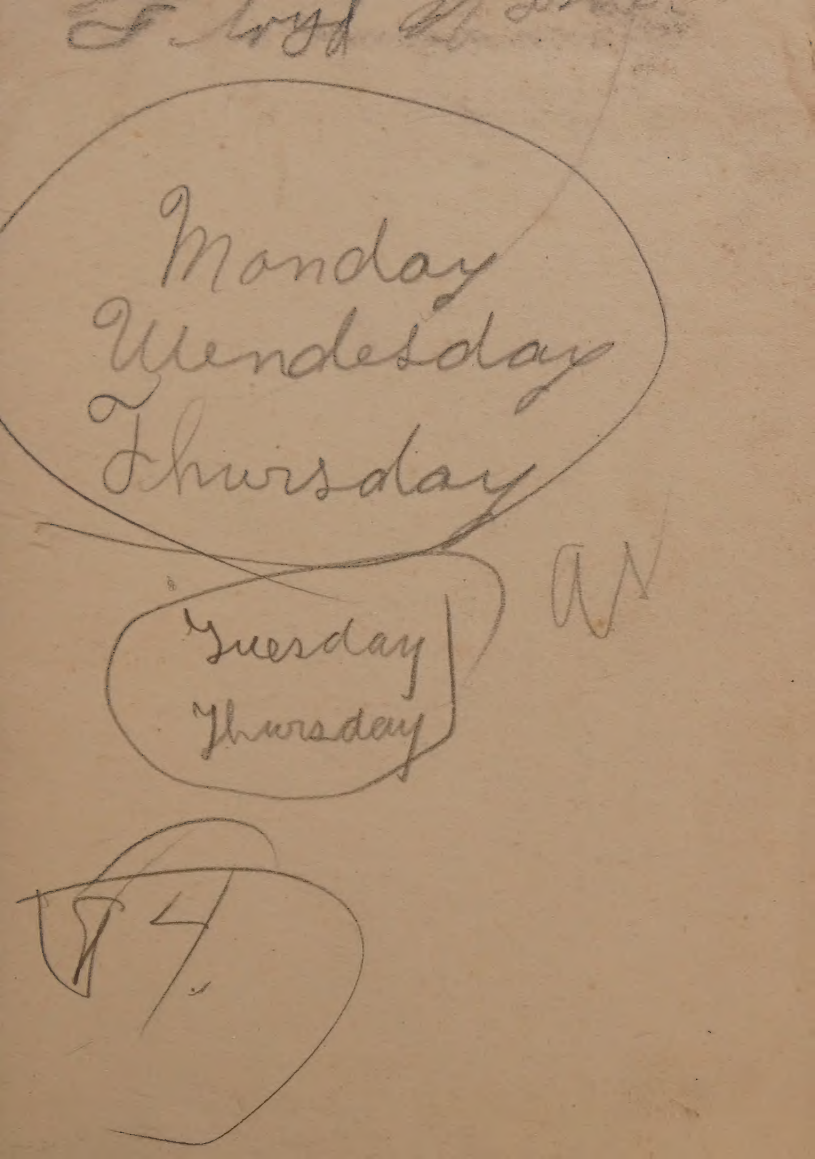
HUTCHISON'S
PHYSIOLOGICAL SERIES

OUR WONDERFUL BODIES

SECOND BOOK

CHARLES·E·MERRILL CO.
44·60·EAST·23·STREET
NEW·YORK·

Tuesday
Yuther & Chuck


Monday
Wendesday
Thursday
Tuesday
Thursday
84

Our Wonderful Bodies

and

How to Take Care of Them

Second Book—For Intermediate and Grammar Grades

New York
Charles E. Merrill Co., Publishers
1908

COPYRIGHT 1895
MAYNARD, MERRILL, & Co.

Preface

THIS work has been designed for use in Intermediate and Grammar Schools for the purpose of teaching the first rudiments of physiology and hygiene. The aim has been to present in an attractive and simple manner the fundamental principles by which health is maintained. Necessarily, in a work so elementary as this, only an outline-sketch of anatomy and physiology can be presented, but enough of these sciences will be found to make the subjects clear and comprehensible. All scientific terms have been avoided, and only familiar language has been used, so that the youngest pupil may read and understand it.

The effects of alcohol and narcotics have been most carefully considered, and the facts presented in this connection are in accordance with the latest scientific conclusions. The requirements of all state laws relating to the teaching of these subjects have been fully met. One fourth of the entire text of the book has been devoted to

the consideration of alcohol and narcotics. At the end of each chapter will be found a statement of the effects of alcohol, tobacco, and other narcotics on the different organs or parts of the body.

Acknowledgments are due Miss Clara F. Hall of Brooklyn, N. Y., for her valuable aid in the preparation of this book.

Contents

CHAPTER I

PAGE

THE FRAMEWORK OF THE BODY 7

CHAPTER II

THE MUSCLES 25

CHAPTER III

THE SKIN 39

CHAPTER IV

CIDER AND ALCOHOL 53

CHAPTER V

BEER AND WINE 61

CHAPTER VI

DISTILLATION AND ADULTERATION 70

CHAPTER VII

TOBACCO AND NARCOTICS 77

CHAPTER VIII

FOOD AND DRINK 84

CHAPTER IX

DIGESTION 107

CHAPTER X

THE CIRCULATION OF THE BLOOD 124

CHAPTER XI

PAGE
RESPIRATION 142

CHAPTER XII

THE NERVOUS SYSTEM 161

CHAPTER XIII

THE SPECIAL SENSES 177

CHAPTER XIV

IN CONCLUSION 205

APPENDIX 209

OUR WONDERFUL BODIES

SECOND BOOK

CHAPTER I

THE FRAMEWORK OF THE BODY

1. **The Human Body.** — The human body is the dwelling-place upon earth of that part of us that lives and loves forever and ever,—the soul. Is that difficult for you to understand? You know that you have arms, hands, feet, eyes, ears, and many other parts of the body. You know if you lose a finger, an arm, or a leg that *you* remain. A part of the body may be lost because of an injury; but the part that makes you *you* and *no one else*, the *soul*, remains in the body as long as it is a suitable dwelling-place for it.

2. The body is full of wonders, full of beauty. There are the strong, hard parts, and the delicate,

soft ones. But all parts, strong and delicate alike, are perfectly planned for the support, preservation, and enjoyment of life. As the *bones* are essential to each and all of these purposes, it is fitting that we should begin the study of the human body with a description of them.

3. **The Bones and Their Uses.**—The bones form the framework of the body. We depend upon them for strength in our arms, legs, and back, and for protection to the lungs, stomach, brain, and other soft parts of the body. The more delicate the organ, the more completely does Nature shield it. For example: the brain, which is soft in texture, is enclosed on all sides by the skull; the eye, though it must be near the surface of the body in order that we may see well, is sheltered from injury by the skull and the bones of the face; the lungs, requiring freedom of motion as well as protection, are surrounded by the movable *chest*, composed partly of bone and partly of muscle.

4. **The Size and Shape of the Bones.**—The size and form of the bones vary greatly in different parts of the body. There are, however, but three general classes: the *long* bones, such as those of the limbs; the *short*, as in the wrist; and the *flat*, like the shoulder-blade. The long bones are com-

monly round and hollow at their middle portion, as greater strength is furnished by the same amount of material, if it is in the form of a tube, than if it is a solid pillar of the same length.

5. THE STRUCTURE OF BONE.—Let us examine one of the long bones after it has been sawed through lengthwise (Fig. 1). We notice the hollow central cavity, containing an oily substance called the *marrow*. We find that the outer surface is hard like ivory, and is pierced here and there with small openings for the admission of blood-vessels. The interior, especially at the ends, is comparatively light and porous. So that, although a bone be as hard as stone outside, it is by no means as heavy. If a thin section of bone be examined under the microscope, we discover that it is pierced by numerous fine tubes (Fig. 2). By means of these

FIG. 1.—SECTION OF BONE.

tubes the blood-vessels, which nourish the bones, run to and fro through their inner structure.

6. **The Composition of Bone.**—Bone is partly a mineral and partly an animal substance, united in the proportion of two parts of the former with one of the latter. The animal substance is called *gelatine*, and the mineral substance is *lime*. The bones of children contain more gelatine than lime. That is why they do not break easily, and when they do break, heal or unite rapidly. The bones change constantly during childhood, more lime and less gelatine forming as the child grows older. In the bones of old people there is much more lime than gelatine. The lime makes the bones brittle. When their bones break they do not unite as well nor as rapidly as the bones of children.

Fig. 2.—Structure of Bone.

7. **Properties of the Bones.**—From these facts, made known to us partly by the microscope, we learn that the bones are not so simple and uninteresting as at first appears, but are adapted with wonderful care and skill to all the purposes they are designed to serve. They are strong, but not heavy;

hard, but not brittle; somewhat elastic by reason of the gelatine, and yet solid and firm by reason of the lime. Their exposed portions are so made as to be hard and resisting, while the interior is more sponge-like, and well furnished with blood-vessels which nourish them and cause them to live.

8. **The Skeleton** (Fig. 3).—The bones of the human body are 206 in number, each of which is known to the anatomist by its own name. All of these bones when united in their natural relations form the *Skeleton*. The greater number of the bones are arranged in pairs, one of each kind on each side of the frame. The skeleton contains three important cavities.

9. **Three Important Cavities** (Fig. 4).—The first of these, surmounting the frame, is a box of bone, called the *skull;* below this is a hooped case, or *chest;* and lower down is a bony basin, called the *pelvis*. The two latter compose the *trunk*. The trunk and skull are kept in their proper places by the *spinal column*. Branching from the trunk are two sets of *limbs:* the *arms*, which are attached to the chest by means of the *collar-bone* and *shoulder-blade;* and the *legs*, directly joined to the lower part of the trunk.

10. **Their Uses.**—These three cavities are de-

FIG. 3.—THE SKELETON.

signed for holding and protecting the more delicate parts of the body. Thus, the skull, together with the bones of the face, shelters the brain and the organs of four senses —sight, hearing, smell, and taste. The chest contains the heart, lungs, and great blood-vessels, while the lower part of the trunk holds and shields a variety of organs, chiefly those concerned in nourishing the body.

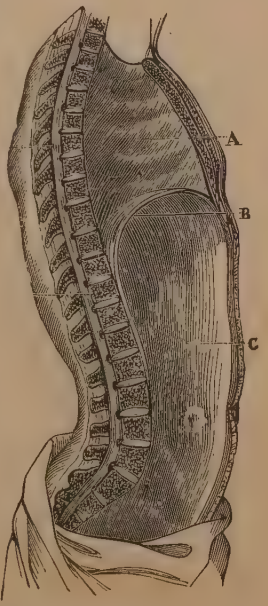


FIG. 4.—SECTION OF THE TRUNK SHOWING THE CAVITIES OF THE CHEST AND ABDOMEN.

11. THE JOINTS (Fig. 5).—The place where two or more bones meet is called a *joint*, the connection being made in various ways according to the kind and amount of motion desired. The movable joints are connected by strong bands, called *ligaments*. These ligaments are of a silvery whiteness, and very tough; so much so, that the bone to which a ligament is attached may be broken, while the ligament itself remains uninjured. When this connecting

material of the joints is strained or torn by an accident, we call the injury a "sprain." An injury of this sort is frequently quite as serious as the breaking of a bone.

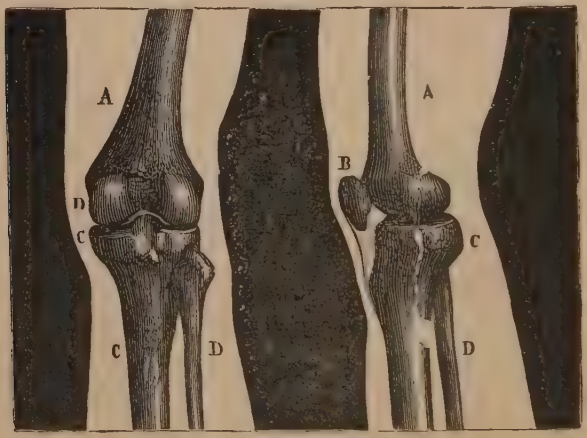


FIG. 5.—KNEE-JOINT.

12. **MOTION IN THE JOINTS.**—The ligaments then make the joints firm and strong. How are they rendered flexible and easy to move? In the first place, the bones are made somewhat broad and flat at the ends, and are so formed that one will fit into the other. In the next place, these ends are covered with a thin layer or cushion of *cartilage*,—an elastic and very smooth material, which not only enables them to move easily over each other, but

also serves, like the springs of a carriage, to deaden the force of jolts and jars. A third provision for smooth motion is a thin sac placed between the ends of the bones, and containing a fluid resembling the white of egg. This fluid serves the same purpose in the joints as the oil that is used on the wheels of a carriage: it saves wear and noise and friction. But it is self-supplied, and flows only so fast as it is used up by the motions of the joint. Some children have the habit of pulling their fingers so as to make them "crack." This is exceedingly wrong, for it is to a certain extent pulling the joints out of their sockets, and this may so loosen the parts as to cause lasting injury.

FIG. 6.—SPINAL COLUMN.

13. **THE SPINAL COLUMN** (Fig. 6).—The spinal column is commonly called the *backbone*, as if it were a single bone, whereas it really consists of a chain of 26 small bones, named *vertebræ*. It contains the spinal cord.

14. The joints of the vertebræ are remarkable for the thick layers of cartilage which separate them.

The amount of motion between any two of these bones is not great; but these little movements, taken together, allow considerable flexibility, or bending, in several directions. The abundant supply of the cartilages also adds greatly to the elasticity of the frame. It is due in part to this elastic material, and in part to the frequent curves of the spine, that the brain and other delicate organs are not more frequently injured by the shock of falls or missteps. During the day the constant pressure upon these joints, while the body is erect, diminishes the thickness of the cartilages; so that a person is not so tall in the evening as in the morning. The effects of this pressure pass away when the body is in a reclining position.

15. The spine has very little time in which to rest or grow during the day, because its strength is devoted to supporting the head, which is much heavier in proportion to its size than any other part of the body. At night, however, the spine can both rest and grow, unless we overtax it by sitting up too late and sleeping too little, particularly in childhood, when the bones have not their full growth. Sometimes people, without thinking how serious the consequences may be, withdraw a chair from some one about to be seated. The sudden fall occasioned by

it results, frequently, in a serious spinal or brain trouble. The cartilages in the spine do their best to protect it and the brain; but nature did not plan for such unnecessary injuries.

16. **The Growth of Bone.**—The bones, like all other parts of the body, are constantly undergoing change, worn-out material passing off to make room for a fresh supply. This change has been shown in the following way: If an animal be fed with madder —a red coloring matter—for a day or two the bones soon become tinged; then, if the madder be discontinued for a few days, the original color returns. If, however, this material be alternately given and withheld at short intervals, the bone will be marked by alternate rings of red and white. In a very young animal all the bones become red in a single day; in old ones a longer time is necessary. The process of waste and repair in the hard bones, therefore, is constantly taking place, and with astonishing rapidity.

17. **The Repair of Bone.**—Nature's provision for uniting broken bones is very complete. First, as a result of the injury, blood is poured out around the ends of the bone. This blood is gradually absorbed and gives place to a watery fluid, which, thickening from day to day, at the end of two weeks becomes a

jelly. This continues to harden by the deposit of new bone-substance until, at the end of five or six weeks, the broken bone may be said to be united. It is, however, still weak, and must be used carefully a few weeks longer. Months pass before the union can be said to be complete, but when firmly united the bone is very strong, and if another accident happens to it, it is quite as liable to break in some new place as at the point of union.

18. **Changes in the Skeleton.**—We do not reach our full height until we are about twenty-five years old. Even after that the bones continue to increase in strength and hardness, but before that age they are soft and flexible because of the gelatine they contain. This is especially true in childhood; and it is fortunate that it is so, since that condition is much more favorable to the steady and rapid growth of the bones than if they contained more of the lime, as is the case in old age when there is no occasion for change in the size or shape of the skeleton. The skull, however, is said to increase slightly in size during the whole life of those persons whose brains are continually employed in thought or study. This very flexibility of the bones, which in early life favors their steady growth and prevents their breaking easily, is sometimes the cause of serious deformity.

19. Babies should not be allowed to stand or walk much before the bones of the legs are strong enough to support the weight of the body. The bones will bend inward or outward if the baby stands or walks when too young. Nearly all babies walk as soon as their legs are strong enough for them to do so. They do not need urging. A bent position of the spinal column should not be permitted habitually in childhood, as it may result in a lifelong deformity.

20. The ribs protect the lungs, heart, stomach, and other soft parts of the body. If tight clothing

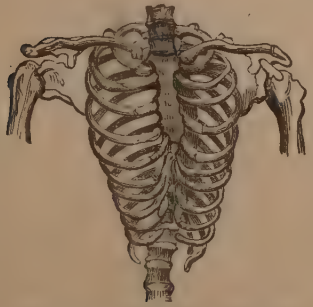


FIG. 7.—RIBS SHOWING THE EFFECT OF TIGHT LACING.

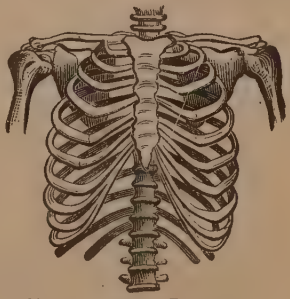


FIG. 8.—THE RIBS IN A NATURAL STATE.

be worn above the waist, the ribs are bent inward, and the soft inner parts of the body are crowded together and are unable to do their work properly (Fig. 7).

21. **The Erect Position.**—Youth is, in a great measure, the forming as well as the growing period of the frame. Bad habits of position, early formed, become fixed in later life, and their results—as seen in contracted chests and round shoulders—are with difficulty remedied. Right habits, on the other hand, tend to produce an erectness of position which is favorable, not alone to strength and health, but also to grace and ease. The following directions should be learned and practiced: hold the head erect with the chin somewhat near the neck; expand the chest in front; throw the shoulders back, keeping them of the same height on both sides; maintain the natural curves of the spine,—as shown in Fig. 9.

Fig. 9.—Correct Standing Position.

22. **Tobacco.**—You have learned that the bones are nourished by the blood; that tubes or openings are found in them through which the nourishment is carried. When anything poisonous is taken into the stomach or lungs, it finds its way all over the body, even into the bones. A poison is anything that

makes people sick or injures the growth of any part of the body. Tobacco is therefore a poison which injures the bones. It makes them less strong, and, in a greater or less degree, dwarfs their growth. That is one reason why men who smoke try to persuade their sons not to do so until they are of age at all events. The fathers know, as all grown people do, and as you know now, that the bones will not be of the same support to the body if tobacco is used either for smoking or chewing, and particularly during boyhood or early manhood.

23. **Alcohol.**—Alcohol also is a poison. It causes the bones to become weaker and more brittle than they should be. Alcohol taken in quantity prevents the proper digestion of food, and in that way deprives the bones of the nourishment which they need. In consequence of this they become brittle and are more liable to be broken. When they do break it is much harder for them to reunite. As the bones should not be brittle in childhood or youth that being the time when they should grow larger and stronger, you can see that it is injurious to drink cider, beer, or any liquor containing alcohol It is injurious to any one to drink alcoholic liquors; but those who have not formed the habit of using them need never suffer from their ill effects.

TABLE OF THE SKELETON

See Fig. 3, page 12.

THE SKELETON CONTAINS 206 BONES.

I. The Head (28 bones).

1. The Skull (8 bones).
   - Forehead.
   - Back of the Head.
   - 2 Bones forming the sides of the Head.
   - 2 Temples.
   - 2 Inner Bones of the Skull.
2. The Face (14 bones).
   - 2 Bones that form the Bridge of the Nose.
   - 3 Inner Bones of the Nose.
   - 2 Cheek-bones.
   - 2 Bones that help protect the Eyes.
   - 2 Bones in the Mouth (Palate-bones).
   - 3 Jaw-bones (two upper and one lower).
3. The Ears (6 bones).
   - 3 Bones in each Ear (Mallet, Anvil, and Stirrup).

II. The Trunk (54 bones).

1. The Spinal Column (26 bones).
   - 24 Vertebræ, and two other bones below them.
2. The Ribs (24 bones).
   - 12 on each side; the upper seven are called "true ribs," the five lower ones are "false" or "floating" ribs. The ribs are all attached to the Spine, and the "true" ribs are also fastened in front to the Breast-bone.
3. A small U-shaped bone in the upper part of the Neck, supporting the base of the Tongue.
4. The Breast-bone.
5. The two Hip-bones.

III. The Arms, Legs, Hands, and Feet (124 bones).

1. The Arms and Hands (64 bones).
   - 2 Collar-bones.
   - 2 Shoulder-blades.
   - 1 Bone in each upper Arm (between Elbow and Shoulder).
   - 2 Bones in each lower or fore Arm (between Wrist and Elbow).
   - 8 Bones in each Wrist.
   - 5 Bones in each Palm.
   - 14 Bones in the Fingers and Thumb of each Hand.
2. The Legs and Feet (60 bones).
   - 2 Thigh-bones (one in each Leg between the Knee and the Hip).
   - 2 Knee-pans.
   - 2 Bones in each Leg below the Knee.
   - 7 Bones in each Ankle.
   - 5 Bones in each Foot between the Ankle and the Toes.
   - 14 Bones in the Toes of each Foot.

QUESTIONS ON CHAPTER I

1. What kind of parts form the body?
2. For what are they planned?
3. What do the bones form?
4. For what do we depend upon them?
5. Into how many classes are bones divided? Name them
6. Why are the long bones hollow?
7. Describe the long bones.
8. How are bones nourished?
9. What substances form the bones?
10. Why do not the bones of children break easily?
11. Why are the bones of old people brittle?
12. Tell the properties of the bones.
13. How many bones are there in the human body? What do they form?
14. Name the three important cavities of the body.
15. What does each protect?
16. What is a joint? How are movable joints connected?
17. Describe ligaments. What is a sprain?
18. What is cartilage? Where is it found? What is its use?
19. Of what use is the fluid which is contained in a sac between the bones?
20. Give the real name of the back-bone. Of what does it consist?
21. Of what use to the spine is the cartilage?
22. During what part of the day are we the shortest? Why?
23. Why, on account of the spine, should young people go to bed early?
24. What playfulness results sometimes in a serious spinal or brain trouble?
25. About how long does it take a broken bone to unite?
26. At what age do we reach our full height?

27. When is the most favorable time for the growth of the bones?

28. In what persons does the skull continue to grow all during life?

29. Why should not babies be allowed to stand or walk when very young?

30. What harm is done if tight clothing be worn above the waist?

31. What directions are given for an erect position either in sitting or standing?

32. When anything poisonous is taken into the stomach or lungs, where does it find its way?

33. What is a poison?

34. How does tobacco injure the bones?

35 What do you know now about the use of tobacco?

36. What besides tobacco is a poison?

37. What effect has it upon the bones?

38. Why, on account of the bones, should not young people drink cider, beer, or any alcoholic liquor?

39. What persons need never suffer from the ill effects of alcohol?

CHAPTER II

THE MUSCLES

1. **The Muscles.**—We have said that the bones support and protect the body, but is it always motionless? Can we not move our arms, hands, legs, and feet? Do we not move from place to

Fig. 10.—The Muscles of the Upper Arm.

place, as in walking or running? How are these movements made? They are made partly by the "will" and partly by the *muscles*. The word *muscle* means "a little mouse," and is supposed to refer to the peculiar sensation felt when a muscle is in

action; for example: grasp the upper portion of the arm while the lower part is caused to move to and fro. The feeling as of a small moving body in the front of the arm is caused by the action of the muscle. This muscle in the arm of a blacksmith becomes large and powerful. (Fig. 10.)

2. **The Uses of the Muscles, or the Flesh.**—The muscles, nearly four hundred in number, form the great bulk of the body, and largely determine its weight and outline. They are nearly all designed to move the bones, but a few act upon the softer parts; for example, those that move the eye, eyelids, and lips. They help also to protect the bones from injury.

3. **The Tendons.**—*Tendons*, or *sinews*, are the extremities of muscles, and are firmly fastened upon the bones. They are very strong, and of a silvery whiteness. They may be felt just beneath the skin, when the muscles are being used, as at the bend of the elbow or knee. We find more of them about the joints, particularly the wrist and ankle joints. The muscles in the front part of the thigh unite to form a single and very powerful tendon. This tendon incloses a small bone called the *knee-pan*, which increases the power and also protects the knee-joint.

4. **Tendon of Achilles.**—The largest tendon in the body is that which goes into the heel and is called the *tendon of Achilles* (Fig. 11), after a Greek hero of that name. The water of the mythical river Styx was said by the ancients to cause any person who bathed in it to be invulnerable; that is, he could not be wounded. When Achilles was a baby, his mother, wishing to prevent his early death, held him by the right heel and dipped him into the river. The heel she held him by was not wet by the water, and it was in that place he received his death-wound.

Fig. 11.—Tendon of Achilles.

5. **Structure of the Muscles.**—The muscles are composed of a soft substance, of a deep red color, which closely resembles the lean meat of beef. Under the microscope we see that they are composed of layers and bundles of small *fibers*, and these are, in turn, made up of still finer fibers, called *fibrillæ* (Fig. 12). The fibers are beautifully marked by regular cross-lines, or stripes, about ten thousand to an inch. These circular markings are

always present in the *voluntary muscles*, and they are known as the *striped muscles.*

6. **Voluntary and Involuntary Muscles.** — The muscles are divided into two classes, the *voluntary* and the *involuntary*. In the first class are those which are used only when we wish or will to use them—as the muscles of the hand or arm. The second includes those which are not under the control of the mind. The heart is an involuntary muscle. We cannot change its action by an effort of the will. During profound sleep, when the will is entirely at rest, the heart continues to beat without cessation. The muscles concerned in breathing are partially under our control, but they are chiefly involuntary, and therefore continue to act while the mind is at rest or is fully occupied in work or play.

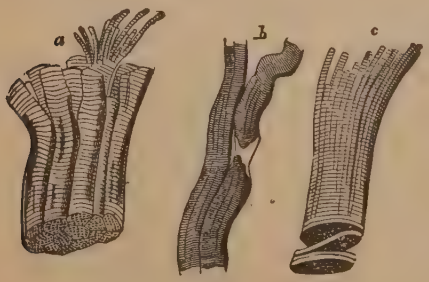


Fig. 12.—Muscular Tissue.

7. **Muscular Contraction.**—Whenever we move a muscle it contracts or grows shorter, and its two ends are brought more nearly together. The raising of the arm, the bending of the finger, and most

of the ordinary movements of the limbs are effected by the will; but the will is not the only means of producing muscular action. Electricity or a sharp blow over a muscle will also produce it.

8. A muscle cannot long remain contracted, but after a short time wearies, and is obliged to relax, or straighten itself out. After a rest it can again contract. For this reason it is more fatiguing to stand in one position for any great length of time, than to be walking.

9. **Relative Strength of Animals.**—The amount of muscular power which different animals possess has been tested by experiment. It is found that the horse, though vastly heavier than man, is relatively not so powerful. Insects are remarkable for their power of carrying objects larger and heavier than themselves. Many of them can drag ten and even twenty times their weight. Some beetles have been known to move bodies more than forty times their own weight.

10. **Physical Strength.**—The difference in strength as seen in different individuals is not due to any original difference in their muscles. Nature gives essentially the same kind and amount of muscles to every healthy person, and the power of one or the

weakness of another arises largely from the manner in which these organs are used or disused.

11. **Importance and Effects of Exercise.**—Every organ needs exercise to keep it strong and well, and to obtain its best services. Exercise consists in a sensible use of the voluntary muscles, but its effects are not limited to the parts used. Other organs are made stronger by it. The heart beats more rapidly, the skin acts more freely, the brain is invigorated, and the appetite and power of digestion are increased.

12. **Change Due to Exercise.**—The first effects of exercise, however, are upon the muscles themselves. If we examine a muscle thus improved by exercise, we find that it has become larger, that its color is of a darker red, and that the supply of blood-vessels has increased. Without exercise the muscle appears thin, soft, and pale. On the other hand, too much exercise, without sufficient rest, causes a similar condition. The muscle then becomes soft and weak, because it is worn out more rapidly than nature builds it up.

13. Violent exercise is not beneficial, as strength is the result of a gradual growth. To gain the best results, exercise should be taken at regular hours

and during a regular period, the amount and time varying with the strength of the individual.

14. **Different Modes of Exercise.**—There are very few who have not the power to walk. It requires no expensive apparatus, no previous training. Walking may be called the universal exercise. With certain foreign nations, the English especially, it is a very popular exercise, and is practiced habitually by almost every class of society. Running, leaping, and other more rapid and violent movements, are the forms of exercise that are most enjoyed in childhood. For the child, they are not too severe, but they may be so prolonged as to become injurious. Instances have been recorded where sudden death has resulted after violent playing, from overtaxing the heart: for example, we have the case of a little girl who, while skipping rope, and trying to excel her playmates by jumping the greatest number of times, fell dead from the bursting of a blood-vessel in the heart.

15. **Open-air Exercise the Best.**—Carriage-riding is particularly well suited to invalids and to elderly people. Horseback exercise brings into use a greater number of muscles than any other one exercise, and with it there is a keen enjoyment which refreshes the mind at the same time. That

form of exercise which interests and diverts the mind will yield the best results; and as exercise in the open air does these two things, besides bringing into play nearly all of the muscles, it is the best. No indoor exercise, however excellent in itself, can fill the place of hearty and vigorous activity in the open air.

16. **Injurious Exercise.**—If too little exercise is injurious, so also is too much. Violent exertions do harm; they often cause great strain, and even lasting injury to some part of the body. Children sometimes try to lift each other, but it is a bad thing to do, as each one takes pride in lifting as large a person as possible; and in so doing risks overtaxing his own back, or straining some of the inner and delicate organs of the body. Sometimes ambitious children overtax their strength in carrying too much weight. It is praiseworthy, certainly, to be ready and willing to help another lift or carry a heavy burden, but it should not be done to the injury of the body. If it is injurious to allow babies to stand or walk before the bones in their legs are strong enough to support them, it is equally injurious for their brothers or sisters only ten or twelve years older to lift them often and carry them about for any length of time.

17. **Caution.**—When it is necessary for a person to go as rapidly as possible to some distant place, to the doctor's, perhaps, a mile or more away, the messenger will gain time by not starting out at full speed, but by increasing it gradually. In cold weather it is very bad to run when first going out into the cold, as the temptation is to run with the mouth open so as to have sufficient air to breathe. This is especially harmful, as there is great danger of chilling the lungs and of producing sudden and serious illness.

18. When a person overtaxes the heart, or, in other words, "gets out of breath," he should regard it as a signal to take rest. "Persons should neither walk, run, leap, nor play at any game, to the extent of producing permanent or painful exhaustion. All exercise should be attended with pleasurable feelings; and when pain is produced by proper exercise, those who suffer should seek medical advice."

19. **Rest.**—It is as necessary to perfect health that we should rest, as it is that we should work or exercise. We rest during sleep and in a change of employment. It is said that Alfred the Great recommended that each day should be divided in the following manner: Eight hours for work, eight hours for recreation or rest, and eight hours for

sleep. This division of time is as good as any that could now be made, if it be borne in mind that, when the work is physical, we should devote the time of recreation to mental pleasures; and when mental, we should rest by means of physical exercise. For instance: farmers, mechanics, and those who perform household duties can find rest in conversation, games, and reading; while book-keepers, professional men, and those who sit at their work need a good deal of exercise in the open air, in order that the brain and the nerves may be rested.

20. **Sleep.**—During sleep all voluntary exercise ceases, the rapidity of the circulation and breathing diminishes, and the temperature of the body falls one or two degrees. In consequence, the body needs warmer coverings than during the hours of wakefulness. During sleep, the body seems wholly at rest; and the mind is also resting, if we except those involuntary mental wanderings which we call dreams. Nevertheless it is not an idle period. Nutrition, or the nourishing of the body, now takes place. While we are awake or exercising, the process of pulling down or wearing out goes on; but when we are asleep, that of building up and strengthening takes place. If the amount of sleep is insufficient, the effects are seen in the lifelessness and

weakness which follow. When any one lies down to take a nap in the daytime, it is always wise to throw a light covering over the shoulders and feet.

21. **Necessary Amount of Sleep.**—Young people between ten and fourteen years of age need at least ten hours of sleep. Frederick the Great required only five hours of sleep daily, and Bonaparte could pass days with only a few hours of rest. But this long-continued absence of sleep is attended with danger.

22. There are instances related of sailors falling asleep on the gun-deck of their ships while in action. On the retreat from Moscow the French soldiers would fall asleep on the march, and could only be aroused by the cry, "The Cossacks are coming!" Tortured persons are said to have slept upon the rack in the intervals of their torture. These instances, and others, show the imperative demand which nature makes for rest in sleep.

23. **Tobacco.**—The muscles are nourished, as the bones are, by the blood. Whatever poison affects the bones affects the muscles also. Tobacco robs the muscles of their firmness, and they become soft. On account of this, they are not so helpful in the support of the body or in the protection of the bones. By and by you will know how the blood

nourishes the bones and muscles; and you know now that some things must never be eaten, because they are poisonous, or unfit to eat. Tobacco is a poison of such a peculiar nature that although it is not taken directly into the stomach, it makes people sick when they begin the use of it. The stomach is a good friend to us, and it tries to show, by its own sickness, the harm there is in the use of tobacco. If the use of tobacco is persisted in, the stomach becomes less sensitive to it, but the muscles are greatly weakened.

FIG. 13.—TOBACCO PLANT.

24. **ALCOHOL.**—Alcohol makes the muscles thinner and weaker by preventing their proper nourishment, or larger and weaker by a deposit of fat which is not natural or healthy. Beer is more liable than any other liquor to produce this unhealthy fat. When the muscles are weakened in any way they cannot be relied upon to help us when we need them. When alcohol is taken in large quantities the muscles of the tongue do not move naturally and the speech is indistinct; the hands be-

come unsteady and lose their firmness and delicacy of touch; and the muscles of the legs become weakened, giving the person so afflicted an unsteady gait, and the liability of falling.

QUESTIONS ON CHAPTER II

1. How are movements of the body made?
2. What does the word "muscle" mean?
3. Of what use are the muscles?
4. What are the tendons? What is another name for them?
5. Where do we find the most of them?
6. What is the largest tendon?
7. Tell the story of Achilles.
8. Of what are muscles composed?
9. What does the microscope show regarding them?
10. What is the difference between the voluntary and involuntary muscles?
11. When a muscle is caused to act, what change takes place in it?
12. How do the muscles rest when they become wearied?
13. How much weight can a man drag?
14. Is a horse stronger in proportion to his size than a man?
15. In what does the strength or weakness of a healthy person consist?
16. Why does every organ need exercise?
17. In what does exercise consist?
18. How are other organs made stronger by it?
19. Describe the appearance of a muscle that has been improved by exercise.
20. When do muscles appear thin, soft, and pale?
21. To gain the best results, how should exercise be taken?
22. What may be called the universal exercise?

23. What exercise is well suited to invalids and elderly people?

24. Why is horseback-riding especially beneficial?

25. What exercise yields the best results?

26. Should children lift one another? Why not?

27. Is it wise to lift or carry heavy burdens? Why not?

28. How can time be gained by a messenger when haste is necessary?

29. Why is it harmful to run in cold weather?

30. What should be regarded as a signal to take rest?

31. What is as necessary to perfect health as exercise?

32. When do we rest?

33. How can school children rest?

34. Why is the body cooler during sleep?

35. What takes place when we are sleeping?

36. How can it be told that people do not have sufficient sleep?

37. How much sleep do you need?

38. Mention a few instances showing the demand nature makes for sleep.

39. How are the muscles nourished?

40. What effect has tobacco upon the muscles?

41. How does tobacco affect people when they begin to use it?

42. What happens to the stomach if the use of tobacco is persisted in?

43. How does alcohol make the muscles thinner and weaker?

44. How does it make them larger and weaker?

45. What liquor is most liable to produce unhealthy fat?

46. What effect has alcohol upon the tongue, hands, and legs?

CHAPTER III

THE SKIN

1. **The Skin** (Fig. 14).—The skin is the outer covering of the body. The parts directly beneath it are very sensitive, as is shown whenever by accident the skin is broken or torn off, the bared surface being very tender and sensitive even to exposure to the air.

2. **The Structure of the Skin.**—When examined closely, the skin is found to be made up of two layers—the outer and the inner. The inner one is called the *dermis* or *true skin;* the outer one is the *epidermis* or *scarf-skin.* These two layers are closely united, but they may be separated from each other. This separation takes place whenever, from a burn or other cause, a blister is formed; a watery fluid forms between the two layers, and lifts the epidermis from the true skin. Another name for the true skin is *cutis*, and for the scarf-skin is *cuticle.*

3. **The Scarf-skin.**—Of the two layers, the outer is the thinner one, and has the appearance of a whitish

membrane. It is tough and elastic; it has no feeling, and does not bleed when cut. On the palm of the hand, where the scarf-skin is especially thick, a needle may be run in and out of it without causing pain or drawing blood. If it be magnified, it will be found to be composed of numberless flat cells or scales, arranged layer upon layer. Its thickness varies in different parts of the body. Where exposed to use it is thick and horn-like, as may be seen on the soles of the feet, or on the palms of the hands of those who are accustomed to perform much manual labor.

FIG. 14.—MAGNIFIED PIECE OF SKIN SHOWING SCARF-SKIN, TRUE SKIN, PORES, ETC.

4. **THE TRUE SKIN.**—The true skin lies beneath the scarf-skin. It is firm, elastic, and very sensitive, and freely supplied with blood-vessels. A needle entering it not only produces pain, but draws blood. The surface is not smooth, but is covered here and there with minute elevations, called *papillæ*. These are arranged in rows or ridges, such as those which can be seen plainly in the palm and thumb. These papillæ contain blood-

vessels and nerves, and are largely concerned in the sense of touch; they are abundant where the touch is most delicate, as at the ends of the fingers.

5. **Changes in the Skin.**—Like all other parts of the body, the scarf-skin is constantly being worn out; it dries, shrivels, and falls from the body in the form of fine flakes or scales. In the scalp these scales form the *dandruff*. As fast as it wears away new skin is formed from beneath. This seemingly simple process is very important, for by it a uniform thickness is secured to the covering of the body. If it were otherwise, this covering would grow thicker as it grew older, like the bark of a tree, and prevent the escape of perspiration, which would be fatal to life. The growth of the true skin is provided for in the blood-vessels which abound in it.

6. **The Nails.**—The nails grow out from the skin near the ends of the fingers and toes, and serve to protect them. Below the skin which covers the lower part of the nail is the root. The nail, if lost, will grow again in a short time, if the root is not injured. We can see how rapidly the nails grow by marking one near the root. Little by little the mark will advance until it reaches the end of the finger-nail. The finger-nails enable us to grasp more firmly and to pick up small objects.

7. **Care of the Nails.**—We should never bite the nails, as it injures the sense of touch and gives to the ends of the fingers an ugly shape. Trim the nails with scissors, but not too closely. Never scrape them with anything hard, as it will injure the polish. Push the skin back carefully about the lower part, near the root, with something blunt. This will prevent *hang-nails*, which we sometimes find so troublesome.

8. **The Hair.**—The hair (Fig. 15), like the nails, grows out of the skin. Each hair grows from a little sac or pocket in the true skin. This sac is filled with oily matter, which keeps the hair moist and glossy. To keep the scalp clean, the hair should be well brushed, and occasionally washed. The growth of the hair is in one direction only—that of length. The hair is very elastic. Hold a hair, several inches long, firmly between the thumb

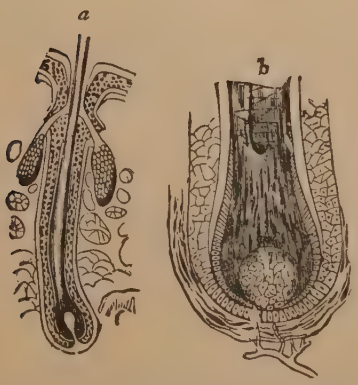


Fig. 15.—*a*, *b*, The Root of a Hair, highly magnified.

and forefinger of each hand, and stretch it gently. Its elasticity will then be felt.

9. **The Color of the Hair.**—The color of the hair is given to it by coloring matter with which little sacs in the layer of the true skin are filled. When these sacs begin to dry up, as when people grow old, or from some other cause, the hair turns gray. Sometimes a sudden fright or a great sorrow has been known to turn the hair white in a few hours.

The hair is a protection to the head, as it shields the brain from extremes of heat and cold, and softens the force of blows upon the scalp.

10. **The Complexion.**—In the deeper cells of the scarf-skin lies a coloring matter consisting of minute colored grains. On this coloring matter *complexion* depends; and its presence in less or greater amount occasions the difference in color that exists between the light and the dark races of men, and between the blonde and brunette of the white races. Freckles are due to an irregular increase of coloring matter.

11. **The Perspiratory Glands.**—There are countless numbers of little sweat-glands in the true skin. They consist of fine tubes which measure about one tenth of an inch in length. In diameter they are about one three-hundredth of an inch, and upon parts of the body there are not far from three

thousand of these glands to the square inch. Their whole number in the body is therefore very great; and it is said that if they were all united, end to end, they would make a tube three miles long.

12. **The Sensible and Insensible Perspiration.**—The pores of the skin are constantly giving out a watery fluid; but, under ordinary circumstances, there is no moisture apparent upon the surface, for it passes off in the form of vapor as rapidly as it is formed. This is called *insensible perspiration.* Under the influence of heat or exercise, however, this fluid is formed more abundantly, and appears on the surface in minute, colorless drops. It is then termed *sensible perspiration.* Water is the chief part of this fluid. The average amount escaping daily from the body by perspiration is not far from two pints.

13. The skin is kept from becoming hard and dry by little oil-sacs which are constantly discharging their contents upon it. The perspiration contains salt which would irritate the skin if it were not for this oily protection.

14. **The Uses of the Perspiration.**—Besides freeing the blood from this large amount of water, with the worn-out matter which it contains, perspiration regulates the temperature of the body, as in evaporating it cools the surface. In hot weather the

perspiration flows more freely, and the cooling influence increases in proportion.

15. The importance of perspiration is shown by the effects that often follow its temporary interruption, namely, headache, fever, and the other symptoms that accompany "taking cold." When its flow is stopped for a considerable time, the consequences are very serious.

16. When one has been exercising freely, or has been heated in any way, and the perspiration has increased accordingly, great care should be taken to avoid draughts of air. It will not do to cool the body too suddenly. It is natural that one should be thirsty then, as the increased perspiration has made more water a necessity. It is dangerous to drink iced water at such times, however, and for the same reason that draughts of air should be avoided.

17. **The Importance of Bathing.**—From what has already been said, it is evident that health must greatly depend upon keeping the skin clean. "He who keeps the skin ruddy and soft, shuts many gates against disease." As the watery portion of the perspiration evaporates, the solid matter is left behind; there also remain the scales of the dead scarf-skin and the excess of oily matter. The healthful action of the skin requires that these

impurities be removed by the frequent application of water.

18. In warm climates and during hot weather bathing is especially necessary. For a person in good health a daily cold bath is advisable. To this should be added occasionally a tepid bath, with soap, water alone not being sufficient to remove impurities of an oily nature. You have, perhaps, heard that "The Three Greatest Physicians" are "water, exercise, and diet."

19. There is a maxim by the chemist Liebig to the effect that the civilization of a nation is high in proportion to the amount of soap that it uses; and that it is low in proportion to its use of perfumes. In some degree we may apply the same test to the refinement of an individual. The soap removes impurity; the perfume covers while retaining it.

20. **The Different Kinds of Baths.**—All persons are not able to use the cold bath. When the health is vigorous, a feeling of increased strength and added warmth upon the surface will show that it is beneficial. Where these pleasurable feelings are not experienced, but rather a chill and sense of weakness follow, we are warned that the system will not endure cold bathing.

21. **Hot Baths.**—It should also be borne in mind

that the warm or hot bath cannot be continued so long or repeated so frequently as the cold, on account of the weakening effect of unusual heat so applied to the body. For persons who are not in robust health one warm bath each week is sufficient. Sea-bathing is even more invigorating than fresh-water bathing. Those who cannot endure the fresh water are often benefited by the salt-water baths.

22. **Time and Manner of Bathing.**—A person in sound health may take a bath at almost any time, except directly after a full meal. The most appropriate time is about three hours after a meal, the noon-hour being probably the best. For the cold bath, taken rapidly, no time is better than immediately after rising. Those beginning the use of cold baths should first try them at 70° Fahr., and gradually use those of a lower temperature. From five to twenty minutes may be considered the proper limit of time to remain in a bath; but a sensation of chilliness is a signal to withdraw instantly, whether at home or at the sea-side. Two sea-baths may be taken daily; one of any other kind is sufficient.

23. **Effects of Bathing.**—The body should be warm, rather than cold, when stepping into the bath; and after it the skin should be thoroughly dried with a coarse towel. It is best to continue friction until

there is a sensation of warmth or "glow" throughout the entire surface. This is the test of the good effects of the bath. If this does not occur, a short walk may be taken, especially in the sunshine. One should not take a cold bath immediately after exercising freely or when the body is over-heated. This is even more dangerous than to remain in a draught or to drink iced water when in a perspiration.

24. **The Sun-bath.**—We may judge somewhat of the benefits of the sun by observing the unnatural and undeveloped condition of plants and animals which are deprived of light. Plants become blanched and tender; the fish of subterranean lakes, where the light of day does not enter, are undersized, and have no eyes; children growing up in mines are sallow, pale, and in some cases deformed.

25. **Clothing.**—More harm arises from using too little than too much clothing, especially in a changeful climate like our own. Some one has said, "We should put off our winter clothing on midsummer's day, and put it on again the day after." The practice of exposing the limbs and necks of young children is very dangerous.

26. **Keep Wrists and Ankles Warm.**—If the wrists

and ankles are kept warm in cold weather it adds greatly to the comfort of the body. Wristers are almost as great a necessity to some people as warm gloves or mittens, and justly so, too; for the blood is very near the surface in the wrists. Low shoes should never be worn out-of-doors in winter. The ankles should always be well protected from the cold and wet. To avoid sore throats keep the feet dry; to avoid lung troubles keep the feet and ankles warm.

27. **Air the Clothing.**—As the skin is constantly acting, by night as well as by day, it is conducive both to cleanliness and comfort to change the clothing entirely on retiring for the night. The day clothing should be aired during the night, and the bedding should be aired in the morning, for the same reason.

28. Woolen clothing of all kinds, and bedding, should be hung out frequently in the open air and sunshine to be sweetened. Feather-beds, mattresses, and pillows should be sunned occasionally for the same reason. If we would have our sleep refreshing, the bedding and pillows should always be sweet.

29. **The Care of the Sick.**—In the care of the sick much depends upon the cleanliness and fresh-

ness of the clothing and bed-linen used by the patient. Even a headache is made more bearable, sometimes, when a fresh, cool pillow-case is made to replace one that has been used for hours. Damp bedding should never be used by the sick or well. See to it that it is thoroughly dry before putting it away or using it. Clean clothes, with plenty of pure air and sunlight, are often the best medicines. These suggestions are not to girls alone; they are to boys too, just as well. If any one, boy or girl, has the wish to make a sick person more comfortable, he will find the way to do it, or to try to do it.

30. **Tobacco.**—Tobacco not only injures the bones and muscles, but it is harmful to the skin. Many people who use tobacco freely become pale and sallow. The poison of tobacco finds its way through the skin, giving it a peculiar odor, and discoloring it by its bad effect upon the liver.

31. **Alcohol.**—Cider, beer, whiskey, or any liquor containing alcohol is bad for the skin. People who drink alcoholic liquors in quantity become pale and yellow like those who use tobacco freely; or they have very red faces. In the latter case the skin becomes in time coarse and thick, losing both its beauty and its delicacy.

QUESTIONS ON CHAPTER III

1. What is the skin?
2. How many layers of skin are there?
3. What is the true skin? Scarf-skin? Epidermis? Cutis? Cuticle?
4. Describe the scarf-skin.
5. Describe the true skin.
6. How is the true skin nourished?
7. Of what use are the finger-nails?
8. What keeps the hair moist and glossy?
9. Why does the hair turn gray?
10. Of what use is the hair?
11. On what does the complexion depend?
12. What are the perspiratory glands?
13. What is sensible perspiration? Insensible perspiration?
14. How much perspiration is given out daily?
15. How is the skin kept from becoming hard and dry?
16. When we are in a perspiration why should we avoid sitting in draughts and drinking iced water?
17. Why is bathing a necessity?
18. Who are "The Three Greatest Physicians"?
19. What effect should be produced by a cold bath?
20. Why should not warm baths be taken as frequently as cold baths?
21. When is the best time for bathing?
22. When is it dangerous to take a cold bath?
23. Describe the condition of plants, fish, and children that are deprived of sunlight.
24. How may we avoid sore throats and lung troubles?
25. What occasionally should be done with woolen clothing, beds, and pillows?
26. In the care of the sick upon what does much depend?

27. What can you say of damp bedding?
28. What are often the best medicines?
29. What effect has tobacco upon the skin?
30. What effect has alcohol upon the skin?

FIG. 16.—HOW APPLES ARE GATHERED.

CHAPTER IV

CIDER AND ALCOHOL

1. **APPLES.**—It has been said that if a man will keep a barrel of apples uncovered in his cellar the year around, and allow his children to go to them whenever they wish to do so, his doctor's bills will be very small. We have never seen a similar statement in

regard to his keeping a barrel of cider for the use of his children. There is a reason for this; and as we are reasonable beings (beings able to reason), we can understand it.

2. During different months of the year different fruits are in season. In the early spring months we have strawberries, a little later we have blackberries, and still later, cherries. In the summer months we have the early apples and peaches; and later we have pears, plums, and grapes. From the time the early apples are ripe the different kinds are constantly ripening until late in the fall. Those that ripen early are not suited to cold weather, and they are not kept in the winter; while the more hardy apples, such as greenings and russets, can be kept throughout the entire winter and spring if they are well packed.

3. The body requires a great deal of water, as you will learn in another chapter. As fruits contain much water they are specially good for us as an article of diet. When apples are not made into cider they are nourishing to the whole body.

4. **Ferments.**—When you look about you in the room in which you are sitting, you may not see any tiny specks of dust floating about; but if you will draw down the shades, or close the shutters, darken-

ing the room as much as possible, and then allow a single ray of sunlight to enter, you will see many of these tiny specks in the sunlight.

5. There are constantly floating in the air tiny plants, too small to be seen without a microscope. Some of these tiny plants are called *ferments*. They are the same kind that live on some parts of the juice of fruits. As long as apples are protected by their skins through which the ferments cannot go, no harm can come to them by these plants. But when the apples are sent to a cider-mill and the juice is pressed out, the ferments lose no time in finding their way into the liquid.

6. If we could keep the juice free from these little plants we might, perhaps, drink it without being poisoned; but that has never been done. "Poisoned?" "Does cider poison people?" "Why do people drink it, then?"

7. There are many kinds of poison. There are some kinds that kill people quickly, and some that take a long while in which to do so. And then, again, some kinds of poison taken in large doses will destroy life immediately, while the same kinds taken in small doses will be much longer in showing their ill-effects. Cider contains a poison which is like the last mentioned.

8. **Effect of Ferments.**—The ferments have a very peculiar effect upon the sugar in the apple-juice. They cause the formation of a gas called *carbonic-acid gas*, and a poisonous liquid called *alcohol*.

9. Alcohol is a colorless liquid that has a burning taste. If taken clear it would burn the mouth and throat badly, and, very likely, would take the skin off. Whiskey is said to be "raw" when it has much of this burning taste, and "smooth" when it is comparatively free from it.

10. Almost immediately after cider is made, alcohol begins to form in it. Cider that has been made a long time, or "hard" cider, as it is called, is about one tenth alcohol. The sweetness has almost entirely gone from it. If it is allowed to remain untouched for a sufficient length of time, it will lose its sweetness entirely and become vinegar. But before this occurs, another change must take place in the apple-juice. This second change is caused by the action of the natural acid in the juice. This acid destroys the alcohol in the liquid.

11. **Water and Alcohol.**—You will remember that we have said that the body needs a great deal of water. Perhaps you think that as alcohol is a liquid it may be good for the body, but it is not; on the

contrary, it is exceedingly injurious, and in more ways than one.

12. Water is good for us because it adds to the strength of the bones and muscles; it helps dissolve or soften the food in the stomach, and it replaces a part of the fluid given off in the form of perspiration. Alcohol weakens the bones and muscles, toughens the food in the stomach, and dries up, by its own heat or power of destroying, the water in the body.

13. You can understand now why alcohol is injurious. As it dries up the water in the body, people who have drunk a large quantity of alcohol are always thirsty. Sometimes they say, "I cannot understand why I am so thirsty when I have drunk so much cider."

14. One of the most serious dangers in connection with the use of cider or of any liquor containing alcohol is the increasing appetite for it. People take it at first thinking it will taste good and quench their thirst. Sometimes as their thirst increases they drink more and more cider, or whatever liquor they have been drinking, thinking if they can drink a sufficient quantity it will surely quench their thirst.

15. **A Dangerous Habit.**—This is always dangerous,

because when a large quantity has been taken into the system the brain loses its power to think, the ears to hear, the eyes to see, the legs to support the body, and the unfortunate drinker falls to the ground in a pitiful condition. There he must lie until he wakes and can go home, or until some friends who are sorry for him carry him there.

16. Aside from producing thirst, alcohol has a very singular effect upon some people. In time many persons as brave and true as we could wish to see, and who know all about the ill-effects of alcohol, become so much in the habit of drinking it that they cannot break themselves of it.

17. Although we may be made very unhappy on account of their misfortune, we have no right to judge them harshly. While we are not responsible for it unless we have tempted them to drink, we can do much for their happiness; and we can resolve that no one shall suffer through us on account of our having formed such a habit. If we never take the first mug or glass of cider, or of any liquor containing alcohol, we shall be safe, and only then.

18. Cider is specially injurious to the liver. Whatever injures the liver hurts the digestion, and whatever hurts the digestion makes people irritable. We must acknowledge then, and facts prove it,

that cider, even in small quantities, makes people cross.

QUESTIONS ON CHAPTER IV

1. How has it been said that a man can, in one way, keep his doctor's bills very small?
2. Has a similar statement been made in regard to cider?
3. What kind of apples can be kept for months?
4. Why are fruits good for us?
5. When are apples not nourishing?
6. When can we see the dust that is ordinarily in the air in any room?
7. What are some of the tiny plants that are found in the air?
8. Upon what do they live?
9. How are apples protected against them?
10. When can the ferments harm them?
11. When could we drink cider without being poisoned?
12. Describe different kinds of poison.
13. To which class or kind belongs cider?
14. What two poisons do ferments produce in cider?
15. How could our lives be destroyed by carbonic-acid gas?
16. Describe alcohol.
17. How would it affect the mouth and throat if taken clear?
18. How soon does alcohol begin to form in cider?
19. What proportion of "hard" cider is alcohol?
20. How is vinegar made of cider?
21. What liquid does the body need?
22. Why is water good for us?
23. Why is alcohol bad for us?
24. Does alcohol quench thirst? Why not?
25. What is a serious danger in the use of cider?
26. Why do people take it at first?

27. What is the effect when a large quantity of alcohol in any form is taken into the system?
28. What very singular effect has alcohol upon people?
29. When are we responsible for this bad habit in people?
30. When are we safe from such a habit?
31. To what part of the body is cider specially injurious?
32. Why should quantities of cider make people cross?

FIG. 17.—DIFFERENT KINDS OF GRAIN.

CHAPTER V

BEER AND WINE

1. **RYE, CORN, AND WHEAT.**—Many of the grains, such as rye, corn, and wheat, are very necessary articles of food. They contain starch, which in the process of ripening or of cooking becomes changed into sugar. Barley is very much like wheat, but is used more for cattle and other live-stock than for

the table. Although grains are so very nourishing when properly prepared for food, they are often sadly misused.

2. **Alcohol Produced from Sugar.**—Anything which contains sugar can be made to yield alcohol when its juice is pressed out, or when it is moistened and kept warm. The sweetness in grains is used in making beer. As the nourishment and sweetness are destroyed in apples when they are made into cider, so the nourishment and sweetness of grains are destroyed when they are made into beer.

3. **Sprouting.**—Have you ever put beans, peas, corn, oats, and other seeds on cotton-wool and kept them covered with water until they have sprouted? Sometimes very pretty and delicate plants can be raised in this way. The dish in which the cotton-wool and the seeds are kept thoroughly moist should stand in a warm place.

4. As the seeds swell on account of the warmth and the moisture, the starch in them changes to sugar. That is why they can sprout. If the water is not changed often it will soon, on account of the heat produced by the sprouting of the seeds, have a very disagreeable odor. Alcohol forms in the water while the seeds are sprouting.

5. **Malt.**—When barley or wheat is to be made

into beer it is moistened and kept warm. The moistened grain is called *malt*. After the grain has begun to sprout it is dried and put away until the time comes when it is to be made into ale, beer, or porter.

6. **YEAST.**—When malt is to be made into beer it is moistened a second time, and yeast is put into the mixture to hasten the formation of alcohol. Yeast is a plant similar to ferments and produces the same effect when it is put into any liquid or juice. The action produced in liquids by ferments or yeast is called *fermentation*.

7. **YEAST HELPS FERMENTATION.** — As alcohol is formed by the heat produced in the sprouting of the grain, and yeast increases the amount of heat, it follows that more alcohol is produced in a given quantity of liquid when yeast is used.

8. Formerly one bushel of grain by natural fermentation yielded alcohol sufficient to make one and one half gallons of whiskey. Now, by increasing the heat in the mixture by using yeast, two or three times the amount of whiskey can be made. As a result the mixture is even more harmful.

9. **ALE AND BEER.**—When the yeast is added to the malt, hops and other things are added to give it flavor. Ale is formed by a more rapid fermenta-

tion than beer and contains, consequently, more alcohol. A given amount of beer does not contain as much alcohol as the same amount of cider does. Home-made beer contains alcohol, as you will know if you stop to think about it. Whether it is made of roots and herbs or of prepared extracts, it is a fermented liquor because yeast is put with it.

10. Cider is said to make people cross; but beer, partly on account of the hops which are used in making it, tends to make people drowsy or stupid.

11. **Hops.**—Sometimes, when people cannot sleep, they are advised to heat a pillow made of hops and put it under their heads so they can have the benefit of its warmth and its soothing properties. It is soothing to the nerves. You can see now why beer taken in large quantities makes people drowsy. It does this partly on account of the hops and partly because of the stupefying effect of the alcohol contained in it. As we do not need beer, and as we know that it is injurious, we can avoid forming the habit of beer-drinking.

12. **Yeast-bread.**—If we should mix flour and water and a little salt and bake the mixture, it would not taste very good to us. The bread that is best liked is yeast-bread. When yeast, which you will remember is similar to ferments, is put with the

flour and water, it changes the sweetness in the flour to carbonic-acid gas and to alcohol.

13. The gas causes the bread to rise. The gas and the alcohol pass off in the oven as the bread is baked, and we are not harmed by them. If the bread is eaten while it is still warm we are in danger of taking some of the alcohol into the stomach. If the dough is not well taken care of, baked at just the right time, and baked suitably, it is likely to be heavy and very hard to digest. If allowed to stand too long before baking it will become sour, as the yeast will destroy all of the sugar in the dough.

14. **Wine.**—Wine is made principally of the juice of grapes, but it may be made of almost any fruit juice. It is made very much as cider is made. The grapes are taken to the wine-press, the juice pressed out, and then, although we cannot see them, the ferments settle themselves in the liquid and begin their peculiar work. They produce the same effect as in cider. They change the sugar in the juice to carbonic-acid gas and to alcohol.

A YOUNG PERSIAN PRINCE. AN OLD STORY.

The ancient Persians brought up their children in a very plain and hardy way.

Until they were twenty-seven years old the boys and young men of Persia were fed on bread, cresses, and water. They were obliged to do a great deal of hard work, to make long journeys, and they slept on hard beds. This plain and temperate life made them strong, active, brave, and healthy.

Cyrus, a young Persian prince, was brought up in this way. When he was twelve years of age his mother took him to visit her father, who was at that time king of Media. But in Media boys and young men were brought up in a very different way from that in which Cyrus had been brought up.

In that country the nobles and their sons dressed in scarlet and gold; they ate rich food and they drank strong wine. Cyrus, who was a bright lad, pleased his grandfather greatly by his simple, kindly manner, his sprightly wit, and by his constant willingness to help and oblige every one who came in his way.

One day Cyrus asked his grandfather if he would allow him to be his cup-bearer for a day or two. His grandfather was very glad to hear this request, and was very glad to grant it.

It was the rule for the cup-bearer of the Median king, before handing wine to his master, to pour some of the wine into his left hand and taste it. This

was the custom at the court, to prove to the king that the wine was safe to drink, and that no enemy had put poison in it.

But when Cyrus handed the wine-cup to his grandfather, he did not taste it. "Cyrus," said his grandfather, "you have forgotten something."

"I am not aware of it," replied Cyrus.

"You did not taste the wine before handing it to me."

"I did not forget it, grandfather."

"Not forget it! What do you mean?"

"I did not intend to taste it."

"Why not, Cyrus?"

"Because I feared there was poison in the wine."

"Poison, child! Why did you not tell me? I would not then have drunk it."

"Yes, poison; for not long ago I was at the banquet that you gave to the lords of your court. I noticed, when they had drunk some of your wine, that they began to talk nonsense or to sing, and that some of them, indeed, could not talk at all. You, too, seemed to have forgotten that you were king. Then when your lords and nobles rose up and wanted to dance, some of them could not even stand straight upon their legs."

"You are an odd child," replied his grandfather.

"Have you never seen the same thing happen to your father?"

"No, never," replied Cyrus.

"What happens, then, when he drinks?"

"Why, he drinks water, and when he has drunk, his thirst is quenched; and that is all."

QUESTIONS ON CHAPTER V

1. What are rye, corn, wheat?
2. Into what is the starch in them changed? How?
3. How is barley sometimes used?
4. What can be made to yield alcohol?
5. Into what are grains made?
6. What becomes of their nourishment and sweetness?
7. How can some pretty and delicate plants be raised?
8. What forms while the seeds are sprouting?
9. What is malt? Into what liquors is it made?
10. When malt is to be made into beer what is put into the liquid? Why?
11. What is yeast? What is fermentation?
12. How does yeast affect the amount of alcohol in a liquid?
13. Does that make the beer more or less harmful?
14. What else is added to the malt in beer-making?
15. Does ale contain more or less alcohol than beer?
16. Of beer and cider, in equal quantities, which contains the more alcohol?
17. Does home-made beer contain alcohol?
18. What effect upon people has beer?
19. To what good use can hops be put?
20. Why does beer make people drowsy?
21. How can we avoid its ill-effects?
22. What kind of bread is best liked?

23. What effect has yeast upon the dough of which bread is made?
24. What effect has the gas upon the dough?
25. Why is not the alcohol injurious to us?
26. When is yeast-bread injurious?
27. What causes dough to become sour?
28. Of what is wine made?
29. What effect have ferments upon grape-juice?
30. Why was not Cyrus's father poisoned by wine?

CHAPTER VI

DISTILLATION AND ADULTERATION

1. **Effects of Alcohol.**—You have been told that cider, ale, beer, porter, and wine contain alcohol. You have learned, also, what is meant by alcohol: that it is a poisonous fluid produced by the fermentation of fruit-juices or of grains. It is injurious to the bones, muscles, and skin, and in succeeding chapters you will learn its effects upon other parts of the body. It sometimes robs a person of all power of thought, hearing, sight, and motion, causing him to fall into an intoxicated sleep which cannot refresh him, but which, for the time, keeps him from doing any further wrong. It is only when large quantities of the liquor have been taken that this heavy sleep occurs.

2. **The Alcohol Habit.**—Alcohol has a peculiar effect upon people in another way. If a liking for the taste of it is formed, no one can tell to what it may lead; and alcohol is irresistible to some people after this liking is formed. They drink it when

they know better, when they know it will make them sick and make very unhappy those whom they dearly love. They do not wish to yield to its coaxing, but they cannot break themselves of the habit of drinking it.

3. **Distillation.**—Some alcoholic liquors are even more injurious in their effects than those we have already mentioned. Gin, rum, whiskey, and brandy are some of them. They are made of alcohol which has been separated from the fermented liquors about which you have already studied. The process by which this separation is made is called *distillation.*

4. **Steam.**—When water boils in the tea-kettle the vapor or steam as it comes from the nose of the tea-kettle is not seen until it becomes condensed into tiny drops which we call *steam.* It really ceases to be steam when it becomes drops. As soon as the steam escapes from the tea-kettle the cold air about it obliges the particles to come closely together, for warmth we might almost say, and when sufficient particles have united they become drops of water.

5. **Distilled Water.**—Water that has been changed into steam and then, by being made to pass through a tube or pipe into a jar or other vessel and allowed to condense or to form drops of water, is *distilled*

water, and it is perfectly pure. If sea-water should be distilled, the salt and other minerals would remain in the kettle, while the steam that escaped would form pure or distilled water.

6. **How Alcohol is Distilled.**—When alcohol is to be distilled, the liquor containing it is heated. As alcohol boils more quickly than the other part of the liquid in which it is contained, it is the alcohol that first passes off in the form of steam. This steam when condensed forms alcohol.

7. **Different Kinds of Liquors.**—Alcohol distilled from sugar-cane or molasses is made into rum; that distilled from grapes is made into brandy; and that distilled from grains is made into gin or whiskey. Or, countries that raise sugar-cane make rum; countries that raise grapes make brandy; and wheat-growing countries make whiskey. From one third to one half of each of these liquors is alcohol.

8. **Adulteration.**—All liquors are liable to be impure; that is, an absolutely pure wine, whiskey, brandy, or gin is rarely found. These impure liquors are said to be adulterated. When liquors are pure they are injurious, but when they are adulterated the danger in their use is largely increased.

9. **Brandy.**—Genuine brandy is distilled from

grape-wine. When first made it is colorless, and it would remain so if it were bottled. As soon as it is made it is put into oaken casks. The color of the wood is absorbed by the brandy, and in time it becomes of the color of tea, growing darker as it grows older. Consequently the age of pure brandy is known by its color. There are not enough grapes made into brandy to supply the amount of what is used under that name. As a result, an impure article is made and sold.

10. Impure brandy is often colored by burnt sugar, and by other substances not as harmless. Some of these substances used in coloring give the brandy such a peculiar taste that other peculiar substances or liquids are used to conceal it, and the liquor finally produced is very far removed from genuine brandy. All very dark brandy is artificially colored.

11. **Wine.**—Wine is made principally from grapes, but it can be made from almost any fruit. Wines are more expensive than other liquors, but they are also, in many cases, less injurious, because they contain less alcohol. Some wines grow darker with age, and some grow lighter. Wines are made in many European countries and also in the United States. Since California has become such a grape-

growing state it has made large quantities of wine. "California wines" are advertised by almost every liquor saloon or store; but it is stated that California can scarcely supply the demand made for its wine by two western cities. How, then, can so many stores sell California wines?

12. If the above statement is true, the California wines which they sell must be largely adulterated. For the same reason that enough brandy cannot be made to supply the demand, enough wine cannot be made: not enough fruit is used in its manufacture. It is very easy to make impure wines; and they are made and sold in immense quantities. During one month the city authorities of Paris made an examination of 1518 samples of French wines. They found less than sixty-five samples free from adulteration.

13. **Whiskey.**—Whiskey is a more common drink than brandy or wine among those who use alcoholic liquors. It is less expensive than brandy or wine, and it contains more alcohol than many of the cheaper liquors: two reasons why it is used by those who cannot overcome the power which alcohol has over them. Its adulterations or impurities are many and various, from those comparatively harmless to those even more injurious than the

materials usually employed. Whiskey is made, then, of many qualities—from that which is pure to that which has no right to the name of whiskey. It is but a step from the use of the poorest quality of whiskey to alcohol itself; and when that step is taken, one rarely overcomes the power of that liquor. His body cannot long resist its poison, and he lives only to regret having formed the habit of drink.

QUESTIONS ON CHAPTER VI

1. What is alcohol? Mention five liquors that contain it.
2. What happens when large quantities of liquor are taken?
3. What can you say of the alcohol habit?
4. What liquors are more injurious than those mentioned in paragraph 1? Why?
5. What is distillation?
6. What change must occur to steam on cooling?
7. What causes the steam to condense?
8. What is distilled water? Can pure water be made of sea-water?
9. How is alcohol distilled?
10. What kind of alcohol is used in making rum? Brandy? Gin? Whiskey?
11. How much of each of these liquors is alcohol?
12. Are pure liquors often found?
13. What are impure liquors called?
14. Are adulterated liquors more or less harmful than pure liquors?
15. What is the color of brandy when first made?
16. What causes it to change?

17. Why is impure brandy made?
18. Of what is much imported French brandy made?
19. How is impure brandy colored?
20. What can be said of all very dark brandy?
21. From what is wine made?
22. How does wine compare with other liquors in regard to expense and alcohol?
23. Why can California make so much wine?
24. Is it possible for California to supply the demand for its wine?
25. What is sold in place of it?
26. What proof have we that the French wines are not always pure?
27. Why is whiskey so commonly used?
28. What can you say of the adulterations of whiskey?
29. What may follow the use of the poorest quality of whiskey? What is the result?

CHAPTER VII

TOBACCO AND NARCOTICS

1. **Nicotine.**—The custom of smoking is so common that you may ask, "Is there really any danger in using tobacco? We know that you have said it is bad for the bones, muscles, and skin, but where is the real danger in it? A good many things are bad for us to do, but who ever died on account of using tobacco?" We do not wonder that you ask these questions. You are young; you may never have seen any of its ill-effects; and, since you were born, many truths regarding the harm done by the use of tobacco have been made known. Tobacco contains a poison called *nicotine* which is able to destroy life. It sometimes causes diseases from which it is impossible to recover. A drop of nicotine put on the tongue of a small animal would kill it within one or two minutes.

2. **Where Tobacco is Raised.**—Tobacco is raised in almost every part of the United States, from the Atlantic to the Pacific, and from Canada to the Gulf

of Mexico. It is raised also in other countries, but not so extensively as here. It grows to a height of six or eight feet and has large, broad, and light green leaves. The tobacco raised in the different States has marked peculiarities; so much so, that good judges of tobacco can tell, very often, in which State it was raised. From 600 to 1000 pounds can be raised on an acre.

3. **Connecticut and Virginia.**—Connecticut raises tobacco that has a large, thin leaf which is remarkably fine and silky. Its flavor is not considered as fine as that of the tobacco raised in other States, but it is much used for wrappers, or outer coverings of cigars. It is sent to Cuba for this purpose. Tobacco was raised in Virginia by the earliest settlers there; but in 1616 a law was passed warning the people not to neglect the food-crops for tobacco.

4. **How Tobacco is Prepared for the Market.**—Tobacco is variously prepared to please the taste of those who use it. Molasses, licorice, figs, glycerine, salt, soda, and anise are often used in order that the taste, color, moisture, and aroma may be improved. These additions, except those for aroma, are made into a "sauce" in which the leaves are steeped. Snuff is perfumed with orris-root and rose. Fortunately snuff-taking is going out of fashion in the

United States, and we may be very hopeful that tobacco-chewing and smoking will meet with the same fate at no very distant day. Tobacco was first used in the form of snuff, and it met with serious opposition on the part of physicians and many other people who knew of its dangers. In Russia, at one time, the penalty for taking snuff was to have the nose cut off.

5. **Effects of Tobacco.** — Tobacco, particularly when first used, produces dizziness, faintness, and nausea. If the nausea continues, the pulse becomes weaker, fainting occurs, and sometimes convulsions are caused. When portions of the hand, or arm, or of any part of the body from which the skin has been removed, by a bruise or otherwise, have been touched by powdered tobacco, or tobacco-juice, severe cases of poisoning have resulted, and sometimes loss of life.

6. **Never use Tobacco.**—Young people, or those whose full growth has not been reached, should never use tobacco, as it is especially injurious to their proper development. It is injurious both to the body and the mind. As a cigar is smoked the nicotine accumulates in the stub, or the end held between the teeth. That is one reason why some men throw away their cigars half smoked. They

do not like them after they become so strong. Those who smoke pipes are more liable to smoke tobacco that has been adulterated or made of poor materials.

7. **Tobacco-chewing.**—Pernaps it will be sufficient to say on this subject that we never could understand why some people who chew tobacco become so careless of the condition of their mouths, beards, clothes, and of the rights of others. Because those who chew tobacco cannot swallow the juice, that is no reason why other people should be obliged to see it on the sidewalks, floors of cars and boats, walk over it, or inhale it. It is embarrassing to speak so plainly on this subject, but it would be unnecessary to do so if some of those who chew tobacco would be more thoughtful.

8. **Cigarettes.**—Cigarettes are more harmful than any other form in which tobacco is used. It has been proved again and again that very injurious substances are put into them. Cigarettes are the worst things that are sold under the name of tobacco.

9. **Narcotics.**—Whatever stupefies or dulls the senses and sensibilities, producing an artificial sleep, is a *narcotic*. Narcotics are dangerous under any circumstances and should be used only by physi-

cians who understand the danger in them and know how to counteract it. Opium, morphine, laudanum, tobacco, and alcohol are narcotics.

10. OPIUM.—Opium is made from the juice of the white poppy. The poppy was originally a native of Asia, but it is now raised in many parts of Europe, and in a few of our own States, California being one. The most of the opium used in this country is brought here from Asia. India, Turkey, and Persia export more than other countries. Laudanum is a liquid form of opium made with alcohol. Morphine is another form of opium. The effect of opium is felt within a very few moments after it has entered the system. Physicians sometimes inject very small doses of it under the skin of people who are suffering terrible pain, and relief is felt almost immediately. The quickness of the relief is a proof of the danger in the drug. If it should ever be taken by mistake, or by one who does not under-

FIG. 18.—POPPY PLANT.

stand the danger in it, do not let the one who has taken it go to sleep. Keep him running, walking, or moving as long as possible. Give him mustard and water to drink, for that will help him to empty his stomach of the poison.

11. **Quieting Medicines.**—Opium is found in the so-called "soothing" or "quieting" medicines. Sometimes babies are kept quiet by them while their mothers or nurses work, read, or do something else than give the babies the care they need. Never use anything of the kind. If the little ones do not actually lose their lives by its use, they are more than likely to be seriously injured by it.

QUESTIONS ON CHAPTER VII

1. What three parts of the body are injured by tobacco?
2. What poison is contained in tobacco?
3. Why do we know it is a poison?
4. What will one drop of nicotine do to a small animal?
5. Where is tobacco raised?
6. Do all the States raise the same kind of tobacco?
7. How many pounds can be raised on an acre?
8. Describe the tobacco raised by Connecticut.
9. What law relating to tobacco was passed in 1616?
10. Why are molasses, glycerine, salt, anise, and other things used with tobacco? In what form was tobacco first used?
11. What effect upon the body has tobacco?
12. What effect has powdered tobacco upon parts of the body that have lost the skin?

13. Who in particular should never use tobacco? Why?
14. Why does a cigar grow stronger as it is smoked?
15. Why, in one way, is pipe-smoking more liable to be injurious than cigar-smoking?
16. Is tobacco-chewing a neat habit?
17. What can be said against the use of cigarettes?
18. What is a narcotic?
19. Name five narcotics.
20. From what countries in Asia is opium imported?
21. Of what are morphine and laudanum different forms?
22. How soon is the effect of opium felt?
23. How do physicians sometimes use it?
24. What should be done for any one who has taken it by mistake?
25. Why are "soothing" or "quieting" medicines so injurious to children?
26. What effect have they upon babies?

FIG. 19.—HARVESTING CORN.

CHAPTER VIII

FOOD AND DRINK

1. **WHY WE NEED FOOD.**—A watch, when well taken care of and wound at regular intervals, is a valuable possession. A sewing-machine, when kept clean and well oiled, saves a great deal of time and strength. A fire, when properly fed with wood or coal, will keep us warm and supply the necessary heat for cooking the food which we need.

2. Whenever we move, or breathe, or think, we use up some of our strength, we begin to wear out,

and we lose some of our heat. We have begun to run down like a watch, to wear out like a machine, and to grow cold as a stove does when the fire is going out. The right kinds of food, when properly prepared and taken at regular hours, will make up for the loss of strength, for the wear of the body, and for its loss of heat.

3. **The Choice of Food.**—Our bodies are given to us for many purposes, useful, beautiful, and wonderful. They deserve the best of care, not alone for our own health and happiness, but for the health and happiness of those about us. We have heard people say, "I am ashamed to be sick, because I feel that I am to blame for it." In many instances we *are* the ones to be blamed when we are taken ill. The subject of food is an important one in connection with health; and as it is almost wholly within our power to decide what we will eat and drink, we may thank ourselves for good health, or reproach ourselves for poor health, in so far as a wise or a poor choice of food is concerned.

4. **Quantity of Food.**—The quantity of food needed depends upon many things. Children need more food than grown people. Those who spend much time in the open air need more food than those who spend the most of their time within doors. Those

who work hard with their bodies need more food than those who can sit while they work, or who study a great deal; and those who live in cold countries need more food than those who live in warm countries. During cold weather more food is needed than during warm weather. Children need food to supply the material for new growth, as well as for health, strength, and warmth. The different parts of the body get from the food which we eat and from the air which we breathe whatever they need to keep them well and strong.

5. **What is Food?**—Food is that which nourishes the body; that is, food is material, in solid or liquid form, which can be changed by digestion into parts exactly like the body. After this change has been made, the nourishment obtained from the food is carried to every part of the body. These are very wonderful things, and you will learn all about them in the next two chapters. Our food consists chiefly of water, salt, vegetables, grains, and meat. The first four are obtained directly from the earth. As meat is the flesh of animals, and animals feed upon vegetables, grains, and grasses, we can truly say that our food is obtained entirely from the earth. Hay and husks of corn are changed by cattle into

milk and meat; and corn and meal are changed by poultry into eggs and meat.

6. **The Care of Animals.**—Every one knows that cattle and sheep should be well taken care of if we would have their flesh of good quality and flavor, if we would have the cows give good milk and the sheep give us fine wool. But are we careful enough of the animals that give us pork in all its varieties? All animals are nourished by what they eat, and we are nourished partly by their flesh. Some families seem to think that anything is good enough for the pig, and that a pig is bound to be dirty on account of its habit of wallowing in the mud in its pen.

7. **Organic and Inorganic Substances.**—Substances or materials which we use as food are divided into two classes, organic and inorganic substances. Organic substances are obtained from vegetables and animals. Inorganic substances belong to the mineral kingdom. Water and salt belong to this class.

8. **Water.**—Water is the most necessary of all food-substances. Without water or any food a strong man can live at the utmost one week. With water alone he can live three weeks or even longer.

9. **Pure Water.**—It is very important to have our drinking-water pure. If it is not, the dirt and impure matter that it contains will injure us. Rain-

water is the purest water in nature; but even that, in falling through the air, catches the particles of dust that are constantly carried up from the ground.

10. **Well-water.**—Well-water that is sparkling is often the most impure water we have, although it is generally thought to be the best. It takes up from the ground gases made from decaying vegetable or animal matter, and these gases give it the beautiful sparkle. Spring-water is much better than well-water, as the well is frequently in the neighborhood of an out-house drain or barn whose impurities soak into the ground and pollute the water. If there is any doubt about the purity of drinking-water, it is best to boil it. In that way the impurities become harmless. Distilled water which is perfectly pure can be had in large cities. Good filters will take impurities from the water, and make even muddy water quite clear.

11. Cisterns and wells should be cleaned once or twice a year. It is almost impossible to keep impurities out of them, and the health depends largely upon pure water. The sides of cisterns and the stones in wells are covered with slime sometimes when the water is low in them, and if left there it will soon make the water impure. Pure water

should be clear and colorless, with little or no taste and no smell.

12. **Water in Pipes.**—Water that is brought into houses through pipes should be allowed to run for a few moments every morning before using any of it. The impurities that have settled in the pipes during the night should be washed out by the running water before any of it is used for drinking or in preparing the breakfast. It is not well to use the hot water in the boiler for cooking purposes.

13. **Common Salt.**—Salt, as an article of food, is obtained chiefly from the mineral kingdom; although plants contain it in small quantities, and it is also found in the flesh of nearly all animals used as food. Even the water we drink sometimes contains salt. In the human body it is found in all the solids and fluids. The importance of salt is shown by the value placed upon it in countries where it is rare. On the gold coast of Africa a handful of it will buy one or two slaves; next to gold it is their most valuable possession. Its necessity to animal life is seen in the great appetite for it among domestic animals, and because herds of wild beasts go regularly to the "salt-licks" or springs.

14. Experiments upon domestic animals show that if they cannot have salt with their food their hides

grow rough, the hair falls out, and they cannot properly digest their food. They would die of starvation if they could not have salt.

15. **Organic Substances.**—The organic food-substances are obtained from the vegetable and animal kingdoms. They include all of those articles which are commonly spoken of as "food." They are divided into three groups: (1) the *Albuminoids*, or the flesh-producers. Among these are albumen, or

Fig. 20.—An Esquimau Village.

white of eggs; a part of cheese; gluten from wheat; and the lean part of meat.

16. (2) The *Fats* or *Oils*, or the great heat-producers. Among these are butter, lard, olive, and other vege-

table oils. In cold climates the fat of animals is the chief article of food, but where vegetation is scanty and not very nourishing the people live upon fish or whales which can be caught in the waters near them. The Esquimau consumes daily from ten to fifteen pounds of meat or blubber, a large portion of which is fat. The Laplander will drink whale-oil, and regards tallow-candles as a great delicacy. In hot climates, on the other hand, a vegetable fat is supplied by the olive and the palm.

17. (3) The *Sugars*, like the last group, are *heat-producers*. They are, with the exception of the sugar of milk and honey, obtained chiefly from sugar-cane, maple-trees and beets. The sweet-tasting fruits, such as grapes, pears, peaches, and cherries, are rich in grape-sugar. In this group *starch* is placed, for the reason that it must be changed into sugar by digestion before it can take part in building up the body.

FIG. 21.—GRANULES OF STARCH MAGNIFIED.

18. The grains, wheat, corn, and rye, which are

made into bread of different kinds are more than one half starch. Rice, which is the principal food of one third of the human family, contains more starch than any other grain. Unripe fruits have much starch in them, which makes them indigestible when eaten uncooked; for raw starch is only slightly acted upon within the body. But under the sun's rays this raw material is changed into sugar. When apple-seeds are very dark, it is safe to eat the apple. The starch in it has been changed to sugar.

19. **Necessity of a Regulated Diet.**—These three organic food-groups are each essential to life. Not one of them can be used alone without danger to health and life. An animal can be starved to death on the white of egg, or on butter, or on pure sugar, which represent the three classes. But if these are given together, or are changed often, it will live and thrive.

20. **Milk.**—Milk may be regarded as the model food, no other single article being capable of sustaining life so long. Cow's milk contains one of the albuminoids, about five parts in one hundred; a fatty substance known as butter, about four parts; sugar of milk, four parts; water and salts, eighty-seven parts. The albuminoid and fatty substances are far more digestible in milk than after they have

been separated from it in the form of cheese and butter. Cheese cooked in any way is exceedingly bad to digest. Good butter is a necessary article of food. Bad butter of every description should be avoided.

21. **The Egg.**—The egg contains about two thirds water, the rest being pure albumen and fat. The fat is in the yolk, and gives it its yellow color. Eggs contain none of the sugars, and should be eaten with bread or vegetables that contain them. Soft-boiled eggs are more wholesome than those which are hard-boiled or fried, as the latter require a longer time to digest.

22. **Meats.**—Meats are obtained from the flesh of various animals. They are most important articles of food for grown people, inasmuch as they are richly stored with albuminoid substances and contain more or less fat. Such food is very nourishing and easily digested if eaten when fresh,—veal and pork being exceptions. The flesh of young animals is more tender and, in general, more digestible than that of older ones. All meat is tough when first prepared for market, but improves by being kept a certain length of time.

23. Cold is one means of preserving meat. In the markets of northern Russia the frozen carcasses of

animals are exposed for sale in the winter air for a considerable time, and are sawed into pieces, like sticks of wood, as the purchases are made; such meat, when thawed, is entirely fit for food. Beef and pork are preserved by salting down in brine, and in this condition may be carried on long voyages or kept for future use.

24. Salted meat is not as nourishing as fresh meat, since the brine absorbs its rich juices and hardens its fibres. It makes the food eaten with it taste good because the salt acts as a "relish," as we say. Food of any kind is more nourishing when it tastes good and is delicately served. When food appeals to the eye it is generally more pleasing to the taste.

25. **Cooking.**—The preparation of food by cooking is customary even among the rudest nations. The object of cooking is to render food more easy of digestion by softening it, to develop its flavor, and to raise its temperature more nearly to that of the body. A few articles of flesh-food, such as oysters, are eaten uncooked in civilized lands.

26. The water in which meat is boiled tends to dissolve its nourishing juices. In fact, the cooking may be so conducted as to rob the meat of all its nourishment, its tenderness, and even of its flavor.

The proper method, in order to preserve these qualities, is to place the meat in boiling water, which, after a few minutes, should be reduced in temperature. In this way the intense heat, at first, hardens the outside of the meat and prevents the escape of the delicate juices; after that, moderate heat best softens it throughout. When soup is to be made, an opposite course should be pursued; for then the object is to extract the juices. Meat, for such purpose, should be cut in small pieces and put into cold water, which should then be gradually raised to boiling heat.

27. Roasting is probably the best method of cooking meat, especially large pieces, as by this process the meat is cooked in its own juices. Roasting should begin with intense heat, and be continued at a moderate temperature, in order to prevent the drying out of the juices, as by this process an outer coating or crust of albumen is formed. During this process the meat loses one fourth of its weight, but the loss is almost wholly water, evaporated by the heat. Too intense or prolonged heat will dry the meat or burn it.

28. Ham, sausages, and other forms of pork should never be eaten raw or imperfectly cooked; as they might, in that condition, cause a painful and

serious illness. When they are thoroughly cooked there is nothing to fear.

29. **Fish.**—The part of fish that is eaten is the muscle. It closely resembles meat, but is more watery. Some varieties are very easy of digestion, such as salmon, trout, and cod; many others are quite indigestible, especially lobsters, clams, and other kinds of shell-fish.

Fig. 22.—Different Kinds of Vegetables.

30. **Vegetable Food.**—Vegetables contain salts which we need to keep the blood pure. The list of them is a very long one, and includes the grains from which our breadstuffs are made, the vegetables from the garden, and the fruits. Tea, coffee,

and other substances from which drinks are made are of vegetable origin.

All the products of the vegetable kingdom are not alike useful. Some are positively hurtful; indeed, the most deadly poisons are obtained from certain vegetables. Of such vegetables as have been found good for food, some are more nourishing than others; some require very little preparation for use, while others are hard and indigestible. Great care must therefore be exercised, and many experiments made, before we can arrive at a complete knowledge in reference to these articles of diet.

31. **Bread.** — Bread made from wheat-flour has been in use for many hundreds of years, and on this account, as well as because of its highly nourishing properties, has been aptly called "the staff of life." We never become tired of good bread as an article of daily food.

The white kinds of flour contain more starch and less gluten than the darker, and are therefore less nutritious. The hard-grain wheat yields the best flour. In grinding wheat, the chaff or bran is separated by a process called "bolting." Unbolted flour is used in making Graham bread.

32. The form of bread most easily digested is that which has been "raised" or leavened, as that

makes it lighter. Unleavened bread requires much more mastication, or chewing. Hot bread is unwholesome, because it cannot be thoroughly masticated, but is converted into a pasty, heavy mass that is not easily digested.

33. Wheaten bread contains nearly everything necessary for sustaining life, except fat. This is commonly added in other articles of diet, especially in butter,—"bread and butter," consequently, forming an almost perfect article of food. The following experiment is recorded: "A dog eating only white bread, made of pure wheat, and freely supplied with water, did not live beyond fifty days. He died at the end of that time with all the signs of gradual exhaustion." Death took place, not because there was anything hurtful in the bread, but because of the absence of one or more of the food-substances.

34. **The Potato.**—The common or Irish potato is the vegetable most extensively used in this country and Great Britain. Among the poorer classes in Ireland it is the main article of food. While it is not so rich in nourishment as many kinds of food, it has some very useful qualities. It keeps well from season to season, and men do not tire of it. It is three fourths water, the remainder being chiefly

starch. It is rich in potash and other salts, and is believed to be highly valuable in warding off disease.

35. **Fruits.**—Fruits are produced in this country in great abundance, and are remarkable for their variety and delicious flavor; consequently they are consumed in large quantities, especially during the summer months. They contain a great deal of water, which is one reason why they are so important as an article of food. The moderate use of ripe fruits, in their season, is beneficial, because they offer a pleasant substitute for the more heating diet that is used in cold weather. Unripe fruits contain starch, which, during the process of ripening, is changed into sugar. Such fruits are indigestible and should be avoided; cooking, however, in part removes the objections to them.

36. **Coffee.**—Coffee is an important article of diet for grown people, but is harmful for the young. Some persons who work hard with hand or brain find its effects beneficial. It helps to repair the waste occasioned by hard work, and gives additional strength to every part of the body. This has been proved in many ways.

37. **Tea.**—Tea is a favorite beverage with many people, but it is not as wholesome as coffee. Its

chief merit consists, perhaps, in its being a warm drink. Children should not drink coffee or tea.

FIG. 23.—GATHERING THE COFFEE BERRIES.

Milk is better for them than any other liquid and for many grown people too.

38. **CHOCOLATE.**—Chocolate is made from the seeds of the cocoa-tree, a native of tropical America. Its effects are somewhat like those of coffee and tea, but it is richer in nourishment. If used too fre-

quently, it is found somewhat injurious on account of its richness.

39. **Iced Drinks.**—Iced water, iced milk, and iced tea are never absolutely harmless, and they should be avoided especially at meal-time. The sudden chilling of the stomach is harmful. Ice-cream in small quantities is nourishing and harmless when made of fresh milk or cream and fresh eggs. Although it is in itself so cold, it is eaten slowly, and warmed by the mouth before it reaches the stomach.

40. **Candy.**—"If ice-cream is good for us, is candy bad for us?" Not at all. Candy is not injurious except when it is made of poor materials, or is eaten in large quantities. There is no more reason why you should be denied candy in moderation than there is that people should go without sugar in their tea, coffee, or chocolate.

Candies are sometimes made of poor materials, however, some of which will not dissolve in water; and they are sometimes colored with poisonous substances. If too much candy is eaten it cannot be properly digested, and it causes sickness. You will do well to avoid cheap candy, and to take care not to eat much of any kind of candy. Nuts also are nourishing, but they should be eaten in moderation.

41. **Alcohol not a Food.**—Alcohol is obtained from sugar; but the effect of alcohol upon the human body is quite different from that of sugar. Sugar is nourishing; alcohol taken in quantities robs the body of a part of the nourishment contained in the food. For two hundred years the armies and navies of certain countries were supplied with rum, or some other alcoholic drink under the name of "grog." During recent years careful inquiries have been made to discover whether grog was serviceable or otherwise.

42. The health of the soldiers has been poorer, the number of sick-days greater, and the inability to work more frequent among those to whom the grog was given. These inquiries were made when the quality of the food and all other circumstances were as nearly equal as possible. The conclusion reached is that alcohol is *not* a *food.*

43. **Alcohol in the United States Army.**—Dr. F. H. Hamilton writes concerning the use of spirits by the Army of the Potomac in the late war. One gill of whiskey was, for a time, given daily to each soldier, on the ground that the hardship and exposure of the soldiers demanded it. He condemned the experiment and expressed the hope that "no such experiment will ever be repeated in the armies

of the United States. My conviction is fixed, by the experience and observation of a lifetime, that the regular employment of alcoholic stimulants by a man in health is never, under any circumstances, useful. I make no exception in favor of cold, or heat, or rain, nor indeed in favor of old drinkers, when we consider them as soldiers."

44. **Does Alcohol Enable People to Resist Extreme Cold?**—If this could be proved to be a fact, some of its boasted usefulness would receive support. In extremely cold climates the inhabitants are enabled to live comfortably by consuming great quantities of animal food alone, especially if it is abundantly oily. Will alcohol act in a similar way or assist in maintaining heat? Experience and observation say *no*.

45. The testimony of those who have had experience in the realms of snow and ice is unanimous against the cold-resisting property of alcohol. It is recorded of the men who served in Napoleon's campaign in Russia, under great exposure to cold, that death was hastened by the use of alcohol. The evidence of the Monks of St. Bernard is similar. Numerous Arctic explorers testify that not only is the temporary indulgence liable to result in most serious consequences, but that strong, able-bodied men in the habit of using alcoholic drinks are entirely un-

fitted to resist the cold to which they must be exposed. The natives and travelers alike rely upon fresh animal food, especially fatty food, and avoid alcohol as a danger to life.

QUESTIONS ON CHAPTER VIII

1. What happens to the body when we move, breathe, or think?
2. Why do we need food?
3. Why do our bodies deserve good care?
4. Whose fault is it, sometimes, when we are ill?
5. Upon what does the quantity of food that a person needs depend?
6. Why do children need more food than grown people?
7. What is food?
8. Of what does it chiefly consist? From what is it obtained?
9. Why should good care be taken of cattle and sheep?
10. How are animals nourished?
11. How are we nourished in part?
12. If we would have good pork, how should pigs be fed?
13. Into what two classes are food-substances divided?
14. What is meant by organic substances?
15. What is meant by inorganic substances?
16. What is the most necessary food?
17. What is considered the purest water in nature?
18. Which is sometimes the most impure water we have?
19. Why should wells be dug at a distance from barns, outbuildings, and drains?
20. How can impure water be made harmless?
21. What care should be taken of cisterns and wells?
22. Describe pure water.

23. What care should be taken regarding the use of water that has stood in pipes?

24. Do animals as well as human beings need salt? Why?

25. Into how many classes are organic substances divided? Name them.

26. What substances are found among the albuminoids? The fats or oils? The sugars?

27. Why is starch placed with the sugars?

28. What are the grains?

29. Why are green apples injurious? How can we tell when they are ripe?

30. Could we live wholly on one class of food?

31. What one article of diet is more nourishing than any other? Why is butter of service to the joints? What kind of butter should be avoided? Why?

32. What should be eaten with eggs?

33. Why are meats nourishing? What kind of meat is the least nourishing?

34. Why is food cooked?

35. When should meat be put into boiling water? When into cold water?

36. Why is roasting perhaps the best way in which to cook large pieces of meat?

37. What kind of meat should be thoroughly cooked if we would avoid sickness?

38. What kind of fish are easily digested?

39. Why are vegetables necessary articles of food?

40. Are all vegetables, or products of the vegetable kingdom, good for food?

41. From what source do we obtain tea and coffee?

42. Why has bread been called "the staff of life"?

43. What kind of bread is most easily digested?

44. What is almost a perfect article of food?

45. What necessary articles of food are contained in potatoes?

46. Why are fruits important as food?

47. For whom is coffee an important article of diet? Why?
48. Is tea as nourishing as coffee?
49. Should children drink tea and coffee?
50. What is the best drink for them?
51. How does chocolate compare with tea and coffee as a drink?
52. When, in particular, should iced drinks be avoided? Why are they harmful?
53. Does ice-cream chill the stomach? Why?
54. When is candy injurious? Why is it injurious to eat a good deal of candy?
55. What is the difference in effect between sugar and alcohol?
56. How did the condition of soldiers who were given "grog" compare with that of soldiers who did not have it?
57. What conclusion regarding alcohol has been reached?
58. Has the custom of giving whiskey to the soldiers in the U. S. Army been commended or condemned?
59. How are the inhabitants of cold climates kept warm?
60. Has experience proved that alcohol will enable people to resist extreme cold?
61. Mention three instances in which alcohol has resulted in serious consequences or loss of life when taken "to keep out the cold."
62. On what do natives and travelers rely for protection against the cold?

CHAPTER IX

DIGESTION

1. **Eating.**—We cannot live without eating. When you were too young to ask for food some one took good care that you did not go hungry. When you grew older and could make known your needs you were occasionally allowed to choose for yourselves such food as you liked. In the last chapter you were told what kinds of food are most nourishing.

2. **The Diet.**—The diet may be very simple, entirely free from pies, puddings, cakes, preserves, and all other rich food, and yet be nourishing and enjoyable. Our health depends very largely upon our choice of food, the manner in which it is cooked, and upon digestion, which is the process by which food is prepared to become a part of the body.

3. **Where Digestion Takes Place.**—In the process of digestion, food is changed from a solid to a liquid form, so that it may be easily carried to every part of the body. Digestion takes place in the stomach and intestines. In reality, however, digestion begins

in the mouth. We may say, almost, that it begins in the plate, because there some food, meat for instance, is cut into pieces suitable to be carried to the mouth.

4. **Mastication.**—As soon as food is taken into the mouth it is cut and ground into small pieces by the teeth. In the movements of mastication, or chewing, the work is done by the lower jaw, because that is the one that can move.

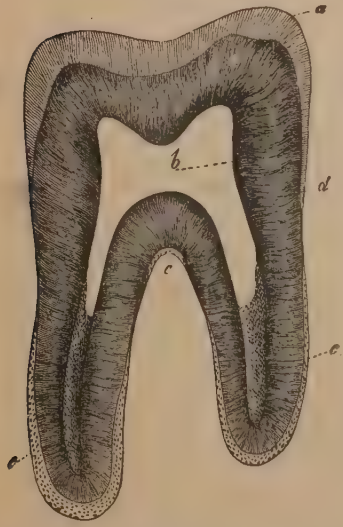


Fig. 21.—Section of a Tooth. *a*, Enamel; *b*, Cavity; *c c*, roots, *d*. Body of the Tooth.

5. **The Teeth** (Figs. 24 and 25).—The teeth are hard, white, bone-like bodies, held in place by roots running deeply into the jaw. The exposed part, or "crown," is protected by a thin covering of enamel which looks like ivory. It is the hardest substance in the body and is capable of striking fire with steel. The middle of each tooth is hollow, containing blood-vessels and nerves, which enter through a very small opening at the root (Fig. 25).

6. **Number of Teeth.**—There are two sets of teeth.

The first teeth are called the milk-teeth. There are twenty of them, and they are small. At six or eight years of age, when the jaw grows larger, the milk-teeth begin to fall out to make room for the second set (Fig. 25). There are thirty-two teeth in the permanent, or second, set—sixteen in each jaw.

7. **Kinds of Teeth in the Permanent Set.**—The permanent teeth are divided into four classes: *incisors*, *canines*, *bicuspids*, and *molars*. The incisors are small and sharp, for cutting the food. There are eight of them, and they are the four front teeth in each jaw. Next to the incisors are the canines; one on each side of them, making four in all. The two in the upper jaw are called the *eye-teeth* and the two in the lower jaw are called the *stomach-teeth*. The two teeth back of each eye-tooth and back of each stomach-tooth are called the bicuspids. There are eight of them. The double teeth are called molars or grinders. There are six in each jaw; the last three teeth on each side. The last four molars are called wisdom-teeth and do not usually appear until a person is about twenty-one years old.

8. **Care of the Teeth.** — The teeth should be brushed after eating to remove the food that has adhered to them. The enamel, if once destroyed, is never formed again, and the teeth are likely to decay.

On this account we should be careful to avoid biting hard substances that will break the enamel. Children should never crack nuts with their teeth.

9. **Both Sets of Teeth.**—Both sets of teeth require good care. The permanent set is more healthy if the

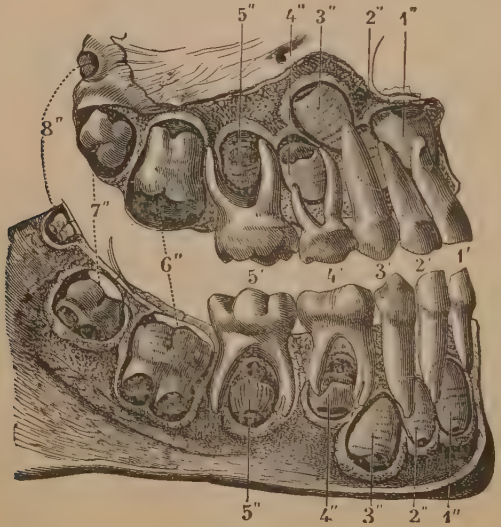


Fig. 25.—Section of the Jaw.

1′, 2′, 3′, 4′, 5′, the Milk-teeth; 1″ to 8″, the Germs of the Permanent Set.

first set receives proper care. Little children can be taught to use a tooth-brush. The first teeth should be filled if necessary. If a dentist is consulted once or twice a year regarding the care of the teeth, he

will know when the enamel is injured, and will repair the injury with little expense and little or no inconvenience to the patient.

10. **The Care of the Enamel.**—When anything is to be removed from between the teeth, do not use metal toothpicks, or pins, as they may crack the enamel, but use a piece of floss such as dentists use, or a wooden toothpick: and do this in private, *never* in the presence of any one. Care should be taken in the use of tooth-powder. Never use anything gritty. Very cold and very hot drinks may crack the enamel.

11. **Saliva.**—As soon as the mastication of the food begins, it is moistened by a colorless, watery, frothy fluid called *saliva*. An *organ* is a part of the body which has a special duty to perform. The *saliva* comes by small tubes from little spongy organs called the *salivary glands*, six in number, situated near the mouth (Fig. 26). They resemble bunches of grapes with tubes for stems and stalks. In the

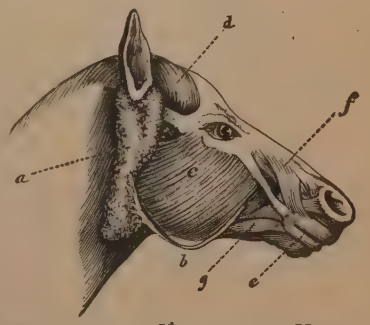


Fig. 26.—The Head of a Horse, showing the large salivary gland (*a*), its duct (*b*), the muscles of mastication (*c*, *d*, *e*, *f*, and *g*).

horse and other animals that feed upon dry and coarse fodder and require an abundant supply of saliva, we find large salivary glands, as well as powerful muscles of mastication. There is sufficient saliva flowing from these glands at all times to keep the mouth moist; but when we are eating, the saliva flows very freely, because it is necessary to the proper moistening of the food.

12. **Uses of Saliva.**—The food is softened and moistened by the saliva. As portions of the food are dissolved or melted by it, we can enjoy the taste of them. Candy would not be enjoyable without the saliva to dissolve it.

13. Food that has been well moistened is easily swallowed. Water and other fluids taken at meal time cannot take the place of saliva; on the other hand they weaken it, and in so doing destroy a portion of the flavor of the food. If the food is properly masticated, the saliva will be sufficient for its moistening.

14. The saliva is useful also in changing starch into sugar; but this change is very slight. The chief use of the saliva is to moisten the food so that it may be easily swallowed.

15. **A Bad Habit.**—Rapid eating is a bad habit to form. The food is swallowed before it is ready for

the stomach to do its work upon it. Can you not remember the scraping sensation caused by food that has been hastily swallowed or improperly masticated? Indigestion may, and frequently does, result from rapid eating.

16. **The Foodpipe.**—The food when swallowed passes through a pipe called the *foodpipe*, or *gullet*, into the stomach. This pipe is about nine inches long.

There is another pipe just in front of the gullet called the *windpipe*. This extends to the lungs, and through it we breathe.

17. When we swallow, the windpipe is covered by a lid, so that no food can enter the lungs. If this lid does not shut quickly enough, a drop of liquid or a small piece of food may enter the windpipe and cause a severe fit of

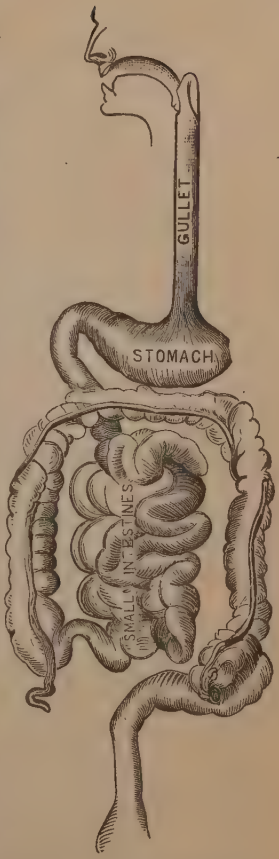


Fig. 27. — Alimentary Canal, including Gullet, Stomach, Large and Small Intestines.

coughing or choking. When people, old or young, try to eat and speak at the same time, there is danger of choking. Never talk when there is any food in the mouth. Laughing is even more dangerous than talking at that time. Sometimes a slap upon the back of one who is choking will help him to cough up the obstacle. Children, when violently choking, should be held with their heads down and heels up, and vigorously shaken or struck between the shoulders.

18. **The Stomach.**—The stomach is a hollow pear-shaped bag (Fig. 29), holding from three pints to two quarts. It has two openings: the one through which the food enters and where the gullet ends is called the *cardiac* or *heart orifice*, because it is near the heart; the other, through which the food goes out and into the intestines, is called the *pylorus*, or "gate-keeper." The pylorus guards the entrance into the intestines, and permits the food to pass out after it has been properly acted upon in the stomach. Things like coins or buttons, that are not food are allowed to pass, because they can be of no use if retained.

19. **The Gastric Juice.**—As soon as the food gets into the stomach an acid fluid, clear and without color, flows out, drop by drop, from millions of little

tubes in its walls. This fluid is called the *gastric juice*, and contains a substance called *pepsin*, which helps us to digest our food. The quantity of gastric juice used for this purpose at each meal is not less than three or four pints.

20. **Action of the Gastric Juice.**—There is also a constant churning motion caused by the contraction of the muscles of the stomach, which mixes the food thoroughly with the gastric juice. This juice acts on the albuminoids which are contained in meat, eggs, and in general all animal substances, but has very little effect on starchy food.

21. **Action of the Stomach.**—If we could see all this wonderful action which is going on in the stomach, how interesting it would be to watch it! On account of an accident which happened, some years ago, to a Canadian, named Alexis St. Martin, doctors have been able to see this process. The man had been shot in the side and an opening, which never closed, was made in his stomach. The opening was about an inch in diameter, and through it the doctors could see how digestion went on, how long a time was required to digest his food, and what things were digested soonest. It was found that about two hours after an ordinary meal his stomach was empty. When he ate food that was not good for him, the in-

side of his stomach looked unusually red, and could not do its work well. You may be sure this man was a great curiosity to the doctors, as well as to other persons who saw him.

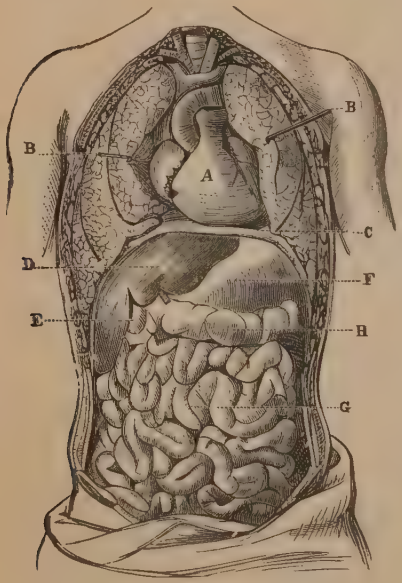


FIG. 28.—SECTION OF CHEST AND ABDOMEN.

A, Heart.
B, The Lungs.
C, Diaphragm.
D, The Liver.
E, Gall Bladder.
F, Stomach.
G, Small Intestine.
H, Large Intestine.

22. **THE INTESTINES.**—The intestines are a continuation of the stomach and consist of a fleshy tube about twenty-five feet long (Fig. 28). The first twenty feet of this tube, called the *small intestines*, is about an inch and a half in diameter; the other five feet, called the *large intestine*, is a continuation of the same tube, though larger round. To get all this length into the small space it occupies in the body, it is folded together a good many times, as we see in the figure.

23. **Food in the Intestines.**—As soon as the food enters the intestines it causes the flow of a new digestive fluid which enters through a small tube below the stomach. This fluid is formed by the union of two fluids, the *bile* and the *pancreatic juice*. The bile is formed by the *liver*, which is on the right side, in the upper part of the abdomen (Fig. 28), and is stored in the *gall-bladder*, a little bag attached to the under side of the liver. Its color is a greenish yellow, and it has a very bitter taste.

24. **Bile and Pancreatic Juice.**—The chief use of bile is to digest the fatty parts of the food upon which the gastric juice does not act. The pancreatic juice comes from the *pancreas*, situated behind the stomach. You may already know it by the name of "sweetbread," as the butchers call it. By means of the bile, the pancreatic juice, and a fluid formed in the intestines, called the *intestinal juice*, the undissolved parts of the food we have eaten are changed in the intestines into a milky-white fluid, and are thus made ready to be taken into the blood.

25. **How the Body is Nourished.**—The blood-vessels of the stomach absorb some of the fluid, but the small intestines absorb the most of it. The inside of the intestines is covered all over with millions of short thread-like bodies called *villi*, which give it

the appearance and smoothness of velvet. These villi contain tubes through which the main absorption takes place. The blood carries the nourishment to the teeth, the eyes, the nails, the bones, the muscles, and to every part of the body.

26. **Circumstances affecting Digestion.**—At the end of three hours after a meal the stomach is ordinarily empty. How much time is needed by the intestines for the digestion of the food is not known. It depends largely upon the amount of starch and fat which the food contains.

27. **Time required for Digestion.**—The length of time required for complete digestion depends upon the kind of food, its amount and temperature. Pork and warm yeast-bread require more time than beef and cold bread. When we are very tired, either in mind or body, the food does not digest as readily. It is therefore a good plan to rest from hard work or romping play during a half-hour before eating.

28. One should not eat immediately after having been very angry, as the stomach is not in condition at that time to digest food. Cheerfulness, on the other hand, aids digestion. In the midst of a great grief or sorrow one cannot eat, and that is well, because the stomach does not act naturally at that time. Happiness, on the contrary, increases the appetite

and helps digestion. The habit of eating between meals is not a good one, because the stomach needs rest as well as any other part of the body. Babies and sick people require food oftener than other people.

29. **Tobacco.**—The effect of tobacco upon digestion is especially harmful. In tobacco-chewing there is a great waste of saliva, as there is in gum-chewing. In addition to the waste of saliva, the other juices are wasted, because they seem to be in constant expectancy of the arrival of food, and they are ready to receive it. The delicate flavors of some foods are lost entirely through the use of tobacco. When first used, it causes a sickness at the stomach which tends to poison the whole system for a time; and certainly the stomach is not for some time after that able to do its work as usual. Smoking, chewing, and all narcotics disturb the action of the stomach. Tobacco is sometimes the cause of fatal illnesses.

30. **Alcohol.** — Alcohol interferes seriously with digestion. It irritates the lining of the stomach, causes the walls of the stomach to grow hard and tough, causes loss of appetite, and the use of it often results in a distressing form of indigestion.

When large amounts of it are taken soon after eating, it prevents digestion and causes great suffer-

ing in that way, or causes the stomach to forcibly free itself from this unnatural fluid.

Alcohol should never be taken on an empty stomach. You may ask now, "When *is* it safe to drink

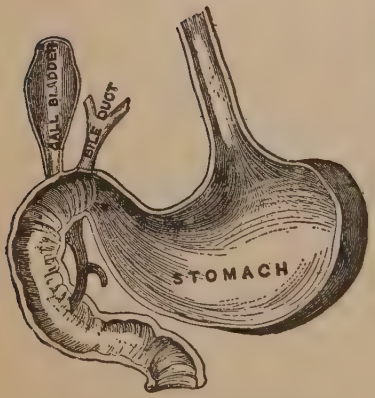


FIG. 29.—THE STOMACH.

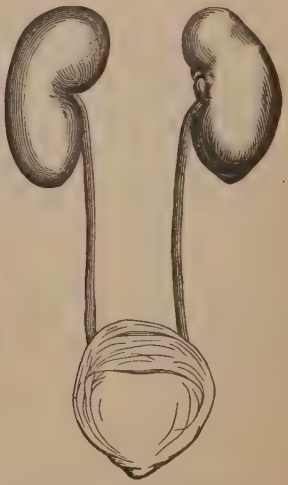


FIG. 30.—THE KIDNEYS.

cider, beer, wine; whiskey, or any one of the alcoholic liquors?" One word answers the question. *Never.* Alcohol dries or destroys the water in the system. It begins by parching the mouth and throat. It has the same effect upon the stomach. The different fluids used in digestion cannot afford to lose the water that the alcohol wastes. Of course, as alcohol creates a thirst, water is drunk,

but the immediate need of water by the different fluids was not supplied. As a result the food is not properly digested. Alcohol toughens the food, making it harder under any circumstances to be digested. The liver, too, is often toughened and hardened and serious liver diseases developed by the use of alcohol. The kidneys suffer also by the use of alcoholic liquors. In fact, no organ of the body escapes unharmed when these liquors are used.

QUESTIONS ON CHAPTER IX

1. Upon what does our health largely depend?
2. What is digestion?
3. Why is food changed to a liquid form?
4. Where does digestion take place?
5. Where in reality does it begin?
6. How is food prepared in the plate for digestion?
7. How do the teeth assist in digestion?
8. What are the teeth?
9. Describe the different parts.
10. How many sets of teeth are there? Tell their names.
11. Describe the milk-teeth.
12. What are the incisors? Canines? Bicuspids? Molars? Wisdom-teeth?
13. Why should the teeth be brushed?
14. What happens if the enamel is destroyed or injured?
15. Why should good care be taken of the first teeth?
16. Why should we go regularly to a dentist?
17. Why are pins and metal toothpicks dangerous to the enamel?

18. When may toothpicks or floss be used?
19. What effect may hot or cold drinks have upon the enamel?
20. What kind of a fluid is saliva?
21. What do the salivary glands resemble?
22. When does the saliva flow most freely? Why?
23. What makes candy taste good? Why?
24. Why do water and other fluids destroy a portion of the taste of food?
25. What effect has the saliva upon starch?
26. What illness may result from rapid eating?
27. What is the foodpipe, or gullet?
28. What is the windpipe?
29. What keeps food and drink out of the windpipe?
30. What is the stomach?
31. What and where are the two openings?
32. What is the gastric juice?
33. What motion has the stomach?
34. What kinds of food does the gastric juice digest?
35. Who was Alexis St. Martin?
36. What are the intestines?
37. How long is the tube which forms the small intestines? The large intestine?
38. What two fluids assist digestion in the intestines?
39. What organ supplies the bile? What is the color and taste of bile?
40. Of what use is the bile?
41. What organ supplies the pancreatic juice?
42. How is the nourishment carried to different parts of the body?
43. How soon after eating is the stomach ordinarily empty?
44. Upon what does the length of time required for digestion depend?
45. When very tired should one eat heartily? Why not?

46. Compare the effect produced upon digestion by anger and cheerfulness. Grief and happiness.

47. Why is it not wise to eat between meals?

48. How does tobacco-chewing waste the saliva?

49. How does tobacco-chewing affect the taste of food?

50. What effect upon the stomach has tobacco when first used?

51. Has tobacco caused death?

52. What effect upon the stomach has alcohol?

53. How does alcohol affect digestion?

54. Should alcohol be taken immediately after eating? Should it be taken on an empty stomach? When is it safe to drink alcoholic liquors?

55. Does alcohol dry the juices needed for digestion?

56. What effect has alcohol upon food?

57. How does alcohol affect the liver?

58. What can be said of all other organs?

CHAPTER X

THE CIRCULATION OF THE BLOOD

1. **Extract from "The History of a Mouthful of Bread."**—Have you ever made up a story of what might be true of an umbrella, a fan, a clock, or a doll, and called it "The History of an Umbrella," "The Biography of a Fan," "The Old Clock's Wonderful Story," or "The Misfortunes of a Doll"? A Frenchman named Macé has written "The History of a Mouthful of Bread," in which he has told many wonderful things that are true, although the story is imaginary. As this chapter will describe the blood, its circulation, and many other things about it, we will tell you what Macé has written about the blood.

2. **The Blood.**—"You feel quite sure that blood is red, do you not? Well, it is no more red than the water of a stream would be if you were to fill it with little red fishes. Suppose the fishes to be very, very small, as small as a grain of sand, and closely crowded together through the whole depth of the stream, the water would look red, would it not?

And this is the way in which the blood looks red; only notice one thing: a grain of sand is a mountain in comparison with the little red bodies that float in the blood, which we have likened to little fishes."

3. **THE BLOOD AN IMPORTANT FLUID.**—The blood is the most important fluid in the body and it is the most abundant. Nourishment is carried by it to every part of the body, and without it we could not live. The blood is said to be about one eighth of the weight of the body. If you weigh eighty pounds, the blood in your body weighs ten pounds; if you weigh one hundred and twenty pounds, the blood weighs fifteen pounds. If you prick your finger, or cut yourself, and lose a few drops of blood you do not feel any weaker on account of it; but if you are seriously injured and lose much blood, you will grow weak very rapidly.

4. **THE COLOR OF THE BLOOD.**—If a drop of blood should be examined with a microscope, it would be found to consist of a colorless fluid and tiny *yellow* bodies. These little bodies are so numerous that they make the blood look red, and we should not know that they are not red if the microscope did not prove it. The colorless fluid containing these tiny bodies consists of water and the nourishment furnished by the food.

5. **The Corpuscles** (Fig. 31).—The little bodies in the blood are called *corpuscles*, because *corpuscle* means "a little body." They are very small, and if piled one above another it would take at least 14,000 of them to stand an inch high. There are two kinds of corpuscles, red corpuscles and white corpuscles. The white ones are larger and fewer than the red ones.

Fig. 31.—The Blood-corpuscles, highly magnified.

6. **The Use of the Corpuscles.**—We need food, and we need something else even more than that: we need air. Air is made of oxygen and nitrogen. We could live only a very short time without oxygen. Every part of the body needs it. We breathe oxygen into our lungs and breathe carbonic-acid gas (a kind of lifeless air) out of them. The corpuscles take up the oxygen we inhale, and carry it all over the body; but the carbonic-acid gas, that would hurt us if it should remain long in the body, they take to the lungs, which expel it. We shall learn more about this in the next chapter, which tells why and how we breathe.

7. **Coagulation.**—As long as the blood remains in

the body it keeps its fluid form; but when it reaches the air it thickens. This thickening, or *coagulation*, of the blood often saves us from bleeding to death, because it stops the mouths of the blood-vessels that have been cut or hurt, so that no more blood can come from them. When you cut yourselves, your parents or the doctor ties up the wound, so that the blood may thicken and thus stop running.

8. **Discovery of the Circulation of the Blood.**—The blood is constantly in motion. It starts from the heart and is carried by a great number of tubes, large and small, all over the body. The flowing of the blood through these tubes is called the *circulation* of the blood. This was not understood until 1619. The man who discovered the circulation of the blood was an Englishman, named William Harvey. He was a physician to the king of England. He was persecuted and ridiculed at first, but he lived nearly forty years after the discovery—long enough to see it accepted by every one, and to know that he was honored as a benefactor of mankind.

9. **The Heart.**—The heart is the wonderful organ by which the circulation of the blood is carried on. It is in the middle of the chest, between the two

lungs, and is placed a little to the left side, where we can easily feel it beat. It is not much larger than your fist. By its constant beating, which is never interrupted or changed excepting by excitement or illness, the blood is kept in motion. (Fig. 32.)

10. **Chambers of the Heart.**—The heart contains four chambers, two on its right side and two on its left, separated by a wall, or partition, extending from the top of the heart to the bottom, so that no blood can pass from one side of the heart to the other. Each of these halves is then divided into an upper and a lower chamber. The upper ones are called the right and left auricles, or ears, the lower ones the right and left ventricles.

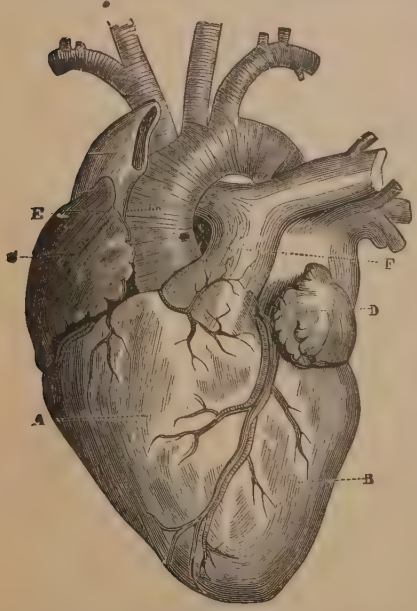


Fig. 32.—The Heart and Large Vessels.
A, Right Ventricle. D, Left Auricle.
B, Left Ventricle. E, Large Artery.
C, Right Auricle. F, Artery to the Lungs.

Each chamber has a little *valve*, or trap-door, which opens to let the blood through, and closes to prevent its return. All these actions of the heart, which are contractions and expansions, are done without our thinking about them. If each heart-beat depended upon our remembering it, we should never be able to attend to anything else, and we could never go to sleep.

11. **The Arteries.**—The tubes by which the blood is carried from the heart to all parts of the body are called *arteries*. The arteries start from the heart by a single hollow tube, which, like the trunk of a tree, throws off many branches. These branches are divided again and again, and constantly become smaller and smaller, until the finest of them are so very minute that we cannot see them without a microscope.

12. **The Veins.**—The tubes by which the blood returns to the heart are the *veins*. At first they are not larger than the smallest artery of which we have spoken, but uniting as they advance, they grow larger, reminding us of the way in which the tiny rootlets of a plant unite to form the root, or the little streams flow together in order to form the mighty river. The large veins commonly lie side by side with the arteries going to the same part of the body,

but the blood within the veins and arteries flows in opposite directions.

13. **The Capillaries.**—There are also other tiny tubes, a great deal finer than the finest hair, which connect the veins and arteries, forming a network between them. These are called *capillaries*, on account of their being so small and hair-like. *Capillus* means a hair. The capillaries carry the blood from the arteries into the small veins, and these veins carry it into two of the largest veins of the body that empty into the right auricle of the heart.

14. **The Circulation of the Blood.**—When the blood has passed through all the arteries of the body, and whatever is needed to nourish the different organs has been taken out of it, its color changes from a bright red to a dark bluish red. It is now impure, and, as it cannot nourish the body, it must be purified. How is this done?

The blood is carried by the veins into the upper chamber of the right side of the heart, which, you have been told, is the right auricle. This chamber contracts, and sends the blood down through the little trap-door into the right ventricle (Fig. 35). This ventricle contracts and sends the blood along the great artery through the lungs, where it is made

pure and red again by the oxygen it gets there, and by the impure gases it throws out.

15. When this is done, the blood is sent out from the lungs into the left auricle, from which, through another little trap-door, it passes into the left ventricle. This contracts and hurries the blood through the large and small arteries to every part of the body. The little capillaries then take it into the small veins, which carry it into the large ones, by which it is taken back into the heart, to begin again the same journey.

16. **The Uses of the Blood.**—What we eat nourishes us when it is properly digested. The nourishment is carried by tiny tubes from the stomach and intestines to the blood. The blood carries nourishment and oxygen to every part of the body, the fluid part of the blood carrying the nourishment, and the corpuscles carrying the oxygen. The blood has another use. It removes the waste particles of matter from different parts of the body and carries the carbonic-acid gas, or lifeless air, back to the lungs to be breathed out by them.

17. **The Circulation of the Blood Briefly Told.**—The circulation of the blood briefly told is this: The blood starts from the left ventricle, flows through the arteries to the capillaries, through the capillaries

to the veins, through the veins to the right auricle, from the right auricle to the right ventricle, from the right ventricle through an artery to the lungs, from the lungs through a vein to the left auricle, from the left auricle to the left ventricle, and from the left ventricle it goes over the same course again and again, never stopping as long as the heart continues to beat.

18. **Appearance of the Blood.**—If you have a microscope, you will be very much interested in looking through it at the circulation of the blood in the web, or thin part, of a frog's foot (Fig. 33). Under the microscope you will see very plainly one set of vessels, the arteries, with the blood rushing through them from the heart, as the water rushes along a rapidly running river; then another set, the veins, with the blood flowing slowing in the opposite direction, as the water creeps along the bed of a sluggish stream; and between the arteries and the veins you can see the capillaries, which form a network with walls so fine that you can see through

Fig. 33.—Margin of Frog's Web, very greatly magnified.

them. Through these capillaries the tiny corpuscles can pass only in "single file."

19. **The Pulse.**—The arteries are not so near the surface of the body as are the veins. There are two good reasons for this. The arteries carry warmth as well as nourishment to all parts of the body, and they should be farther from the surface on that account; and because they carry warmth and nourishment they need to be better protected from injury than the veins. The arteries are obliged to be near the surface in three or four parts of the body, and the wrist is one of them.

20. By putting the fingers on the wrist, just back of the thumb, the throbbing motion of the blood can be felt, as it passes through the artery there. This throbbing motion is called the pulse. A physician can tell by the pulse whether the action of the heart is strong or weak, rapid or slow, regular or irregular, and he will know what to do to make it right.

21. **Time required for the Circulation.**—It is not known exactly how long it takes the blood to make the entire journey through the blood-vessels, from beginning to end, but it is estimated to take from one third to one half of a minute.

22. **The Intelligence of the Corpuscles and Capillaries.**—The corpuscles and capillaries show almost

human intelligence in selecting what is needed by each part of the body, however far away it may be from the heart. The capillaries in the fingers, feet, ears. teeth, bones, and even the heart itself, know just what they must select from the blood as it passes through them, to make and keep their own special parts of the body well and strong. Is there any reason why we should prove ourselves less intelligent than these tiny bodies? There are many things that help or hinder the action of the heart; and whatever does this affects the circulation of the blood. Among these helps or hindrances are the positions of the body, exercise, and the feelings. Our intelligence will be shown by the use which we make of this knowledge.

23. **How Positions of the Body affect the Heart.**—When we are lying in bed or on a couch the heart beats more slowly than at any other time. When we stand it beats more rapidly than when we sit; and when we have been walking or exercising, the heart beats most rapidly of all. When we are very tired, then, from having walked a long distance, or from having worked or played very hard, it is sometimes better to lie down and give the heart a chance to rest a little while before we eat than to give the heart the extra work occasioned by eating.

At such times we should not lie down without being covered by some light, warm wrap.

24. **Exercise helps Recovery from Illness.**—When people have been ill and confined to the bed or to the house for a long time, their physicians often say to them, as soon as they are strong enough to walk about for a little while, "To-morrow, or the first pleasant day, you may go out to walk. The exercise will do you good." Why? Because the exercise of walking makes the heart beat more rapidly, the blood flows more freely, and the body receives strength sooner on that account. The time spent in walking should not be long at first, however. The need of pure air and how to supply it will be told in another chapter.

25. **Anger, Grief, and Cheerfulness.**—Anger causes the heart to beat very fast, while grief causes it to beat slowly. It is possible for a blood-vessel to burst during a fit of anger. We can avoid all danger from anger by not giving way to it; and if we are truly considerate of others, we will not injure their health by causing them unnecessary grief or care.

"In company we have our tongues to watch; in the family, our tempers; and when we are alone, our thoughts." "A merry heart is a good medi-

cine," we are told; and certainly cheerfulness or good humor, by assisting digestion, helps the heart to beat regularly and smoothly.

26. Tight clothing of every description, from hats to boots, should be avoided. It presses upon the blood-vessels and prevents the free circulation of the blood.

27. **How to Stop the Flow of Blood.**—When an artery is cut the blood comes from it in spurts or jets, and the color of the blood is bright red. A bandage should be applied immediately *between* the injury and the *heart*. Do not fear to make it too tight. The flow of blood *must* be stopped. If the blood flows steadily and is of a bluish red, it is from a vein, and the bandage should be applied directly over the wound or *beyond* it, and not between the wound and the heart as in the case of a wounded artery. Sometimes a handful of mud or moist earth will stop the flow of blood.

28. **Tobacco.**—Tobacco causes the heart to beat more rapidly than it is natural for it to do. As this rapid beating is not caused by breathing pure air, by natural exercise, or by the increased supply of nourishment, it is a positive injury to the heart. Tobacco gives the heart more work to do, and no help in doing it; consequently the heart is weakened by

11. A physician knows when certain forms of heart disease are caused by tobacco, and naturally he advises the patient to give it up. It hardly seems worth while to risk losing one's health for the sake of tobacco.

29. **Alcohol.**—The effect of alcohol upon the heart is more serious than its effect upon any other organ of the body. Alcohol is a narcotic because it deadens the nerves, or makes them unable to act naturally. Cider, beer, whiskey, rum, wine, or any alcoholic liquor deadens the nerves that control the flow of blood through the blood-vessels; and as a result the blood flows with greater force and in larger quantity through them. The blood-vessels near the surface of the body become swollen, and they give the face a flushed appearance that is, in reality, a danger-signal. The hands become swollen and red on this account.

Fig. 34.—Capillaries, Arteries, and Veins.

30. **Alcohol and the Brain.**—One reason why alcohol "goes to the head," as we say, is because the brain receives an unusual supply of blood, and becomes dull or stupefied in consequence. Alcohol, like tobacco, causes the heart to do extra work and does not give it the strength with which to do it. The action of the heart is greatly weakened by alcohol.

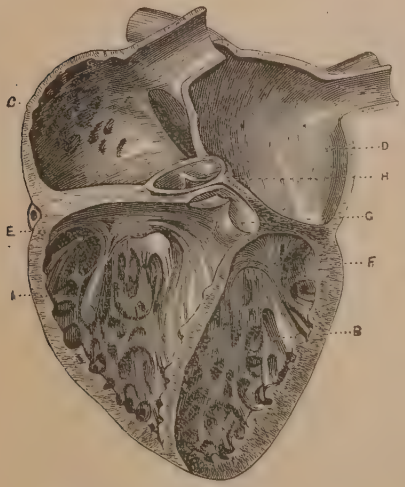


FIG. 35.—SECTION OF HEART.

A, Right Ventricle.
B, Left " "
C, Right Auricle.
D, Left Auricle.
E, F, Inlets to the Ventricles.
G, Artery to the Lungs.
H, Large Artery.

31. **Effect of Alcohol on the Heart.**—As the heart is the most necessary organ of the body, it is dangerous to weaken it in any way. The blood-vessels are weakened by alcohol and are liable to burst. When the bursting of a blood-vessel occurs, it is generally in the head and there is no cure for it. Alcohol thins the blood be-

cause it robs it of the nourishment that it should contain.

When accidents happen either to bones or muscles, it is very difficult to heal them if the blood has been weakened by alcohol. When an "accident" patient is taken to a hospital, one of the first questions asked is, "Do you know if this patient uses alcohol?" The doctors know that if such is the case the recovery of the patient will require more time than usual. Life-insurance companies ask very important questions in regard to the use of tobacco, opium, and alcohol. Some companies will not insure the lives of those who use alcohol; and in some cases they will not insure the lives of those who are employed in breweries or distilleries.

QUESTIONS ON CHAPTER X

1. Is the blood red? Why does it look so?
2. Describe the size of the corpuscles.
3. What is the most important fluid in the body? Why?
4. What is the comparative weight of the blood?
5. Of what does the blood consist?
6. Of what does the fluid consist?
7. What does corpuscle mean?
8. What kinds of corpuscles are there?
9. Of what use are the corpuscles?
10. What happens to the blood when it reaches the air?
11. What is meant by the circulation of the blood?
12. Tell the story of the discovery of the circulation of the blood.

13. What is the heart? Where is it?
14. What keeps the blood in motion?
15. How many divisions has the heart? Describe them.
16. What are their special names?
17. What are the arteries?
18. What are the veins?
19. What are the capillaries? What does *capillus* mean?
20. Describe the change in the color of the blood.
21. Where is the blood made pure and red?
22. Of what use is the blood? Tell what each part of the blood carries to every part of the body.
23. What other uses has the blood?
24. Describe briefly the circulation of the blood.
25. How small are the capillaries?
26. Why are not the arteries near the surface?
27. Where is the pulse felt? What is the pulse?
28. What can a physician tell by it?
29. How much time is required for the blood to make its complete journey through the blood-vessels?
30. How do the corpuscles and capillaries show almost human intelligence?
31. Tell how the position of the body affects the action of the heart.
32. When is it a good plan to lie down before eating?
33. Why does walking help invalids to become stronger?
34. What effect has anger upon the heart? Grief?
35. When should we watch our tongues? Tempers? Thoughts?
36. What effect upon the heart has cheerfulness? Why?
37. Why should tight lacing be avoided?
38. How can we tell when an artery has been cut? Where should the bandage be tied?
39. How can we tell when a vein has been injured? Where should the bandage be tied in that case?
40. What will sometimes stop the flow of blood?

41. What effect has tobacco upon the heart?

42. How does the effect of alcohol upon the heart compare with its effect upon other organs?

43. Why is alcohol a narcotic?

44. What effect has alcohol upon the nerves of the blood-vessels?

45. What happens in consequence?

46. What gives the face its flushed appearance when alcohol is drunk?

47. Why does alcohol weaken the action of the heart?

48. What is the most necessary organ in the body?

49. What may happen to the blood-vessels that have been weakened by alcohol?

50. What effect has alcohol upon the blood?

51. When is it difficult for injured bones or muscles to heal?

52. Will all insurance companies insure the lives of those who use alcohol?

CHAPTER XI

RESPIRATION

1. **Air a Necessity.**—A constant supply of air is more necessary to the body than food or drink. Without air we could not breathe, and without breathing we could not live. Air nourishes the body and purifies the blood. We breathe so easily, so noiselessly, that we do not think much about it, unless we have been exercising violently, or we are in an impure atmosphere, or we are ill with some disease that interferes with our breathing.

The parts of the body and the organs of tne body are wonderfully adapted to their different uses; and we wonder sometimes, as we study them, which one is most perfectly planned. Each one seems perfect in its own way; and without trying to find out which is most perfect, we can be truly happy that they are ours. As they are ours, it is our privilege to take care of them; and this we can do very easily, if we choose to do so. In this

chapter we shall study the organs with which we breathe, and their need of pure air.

2. **The Lungs** (Fig. 36). — The lungs are the organs with which we breathe. There are two of

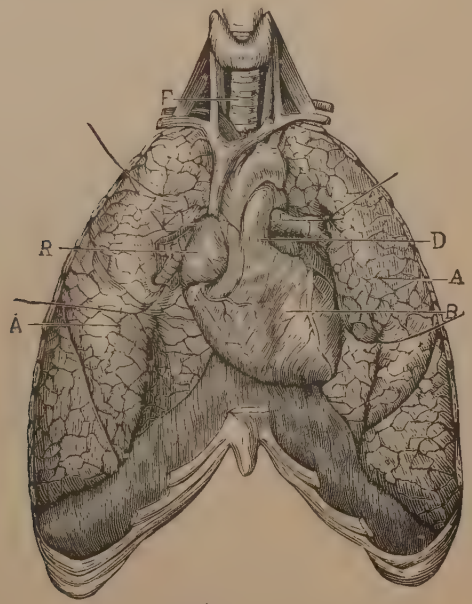


Fig. 36.—Organs of the Chest.

A, Lungs.
B, Heart.
D, Pulmonary Artery.
E, Trachea.

them, one on each side of the chest, which they almost fill. The substance of the lungs is soft,

elastic, and very much like a sponge, and when thrown into water it will float.

3. **The Tubes for the Passage of the Air** (Fig. 41). —Air enters the lungs through the nostrils, mouth, and certain tubes. The longest of these tubes is the *trachea*, or *windpipe*, which passes down the front

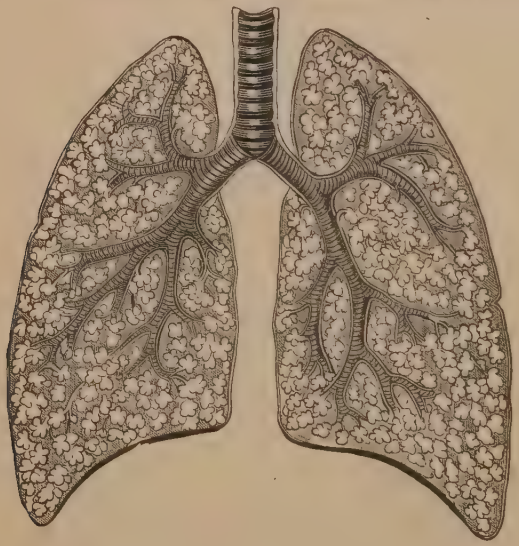


Fig. 37.—Section of the Lungs.

of the neck, in front of the foodpipe. If you should press your fingers upon the windpipe, it would give you an unpleasant sensation. If the pressure should be continued and no air could enter the lungs, you would suffocate.

4. **The Larynx** (Figs. 38 and 41).—At the top of the wind-pipe is a peculiar box called the *larynx*. In that box are the *vocal cords*, two elastic bands by means of which, as air passes over them, we can speak, sing, laugh, and shout. The front of this box is called "Adam's apple," and it can be felt moving up and down when anything is swallowed.

5. **Epiglottis** (Fig. 41).—At the top of the windpipe, which opens at the back of the mouth, is the cover or lid of which we have already spoken. It is called the *epiglottis*. This opens to let the air pass in and out, and closes when we swallow our food. Sometimes it fails to shut down over the opening, and the food goes down the windpipe instead of the foodpipe, causing us to choke until we cough it up again. Do you remember what to do in cases of choking? As choking is liable to occur only in eating or drinking, we spoke of it in that connection.

6. **Bronchial Tubes** (Fig. 38).—The lower end of the windpipe is divided into two parts or branches, one going into each lung (Fig. 37). These large branches are again divided, something like the arteries, into many little branches, or *bronchial tubes* as they are called, which gradually become smaller, until they are as small as the finest hair. On the ends of each of these little tubes is a cluster of little pouches or

"air-cells" (Fig. 39), having very thin walls; and the whole is covered with a very firm network of capillaries, of which we learned in the last chapter. When we take in a breath, these cavities are filled

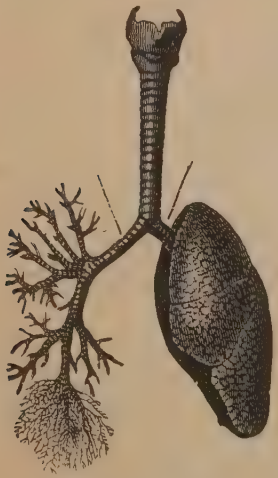


FIG. 38.—LARYNX, TRACHEA, AND BRONCHIAL TUBES.

FIG. 39.—DIAGRAM AND SECTION OF THE AIR-CELLS.

with air and the chest swells out; but when the air is forced out, the chest falls again. The lungs consist principally of these tubes and "air-cells" and the blood-vessels which pass through them.

7. **RESPIRATION.**—The act of breathing consists of two parts—*inspiration*, or drawing air into the lungs,

and *expiration*, or forcing it out again. Inspiration and expiration, the two parts of breathing, are called *respiration*. In inspiration the chest expands in length, breadth, and height so that the lungs may swell. The upward and outward motions of the chest can be seen in the lifting of the ribs. These two motions can be felt by placing the hands on the sides of the body or just below the collar-bone. The downward motion is caused by a muscle or partition within the body called the *diaphragm*. In expiration the chest sinks or falls as the air passes out of the lungs.

8. **The Diaphragm.**—This muscle is a thin partition which separates the chest from the abdomen. In its natural position it rises up into the chest like a dome. When we breathe the air into the lungs it contracts until it is flat. As soon as the air is driven out of the lungs the diaphragm rises into its domelike position again. These movements go on, without our thinking about them, as long as we live.

9. **Rapid and Controlled Breathing.**—We breathe about eighteen times a minute. When the heart beats more rapidly than usual it sends the blood to the lungs more rapidly and we must breathe faster in order to supply the necessary amount of air.

Sometimes the heart beats so fast that we cannot supply all of the air needed, and then we are distressed for the want of it. This takes place when we run until we are "out of breath."

10. Although we breathe unconsciously almost all of the time, the breathing can be controlled somewhat by the will. We can breathe more or less rapidly when we choose to do so, and we can "hold the breath" for twenty or thirty seconds. By practice we can hold the breath for a minute and a half or two minutes. This might be useful to us if we were obliged to pass through a burning building or any place where the air is bad.

11. **Composition of Air.**—The air we breathe is composed of two gases, *oxygen* and *nitrogen*. Oxygen is powerful and burning; too much so for us to breathe unless it is mixed with something else. Nitrogen is weak, and cannot alone support life. These gases are so mixed that there is four times as much nitrogen as oxygen—that is to say, one fifth of common air is oxygen. A Frenchman named Lavoisier made this discovery in 1778.

12. **The Nourishment in Air.**—When air is taken into the lungs it loses oxygen and receives *carbonic-acid gas*. We learned this in the chapter on the circulation. The blood loses carbonic-acid gas and

takes up oxygen. The corpuscles need oxygen, while the fluid portion of the blood needs food and drink. The air, then, supplies one kind of food and articles of diet supply another kind. Air we must have constantly; but food is taken at regular intervals, three or four times only during the day. The sensation of hunger shows that we need food. The sensation of suffocation shows that we need air.

13. **The Exchange of Gases in the Lungs.**—The air and the blood do not come in contact—they are separated by the walls of the air-cells and of the blood-vessels,—how then do the two gases, oxygen and carbonic acid, exchange places? These walls are so thin and delicate that gases can pass through them, although liquids cannot do so. This may be beautifully shown by suspending a bladder containing impure blood in a jar of oxygen. At the end of a few hours the oxygen will have diminished, the blood will be scarlet in color, and carbonic-acid gas will be found in the jar.

14. If this exchange takes place outside of the body, it must take place much more perfectly within it, where the circumstances are more favorable. The walls of the vessels and of the air-cells are thin and moist, and the currents of air and blood are in constant motion. Both parts of this process of ex-

change are equally important. Without oxygen life ceases; if carbonic-acid gas is not thrown off, it acts like a poison, producing unconsciousness, convulsions, and even death.

15. **Causes of Impure Air.**—Stoves and furnaces used for heating rooms often cause death by the gas which they send out. Where such heaters are used, the rooms should have plenty of fresh air. We have sometimes noticed what a close, disagreeable odor there is when we enter a room in which there are a great many persons. It is because fresh air is shut out. The unpleasant odor is caused partly by the animal matter contained in the moisture that is breathed out of our lungs as well as what is thrown off by perspiration. Air that is pure has no odor.

16. When sick we throw off with our breath and from our body impurities that often cause those who are near us to take the disease, or, as we say, to "catch" it. For instance, scarlet-fever, smallpox, measles, and other diseases which we call contagious are given by a person who has them to those who come very near him. The better a sick-room is ventilated, the less liable are those about the patient to take the disease.

17. **Protection against Impure Air.**—The sense of

smell helps us to avoid poisonous and impure air. Coal-gas is easily detected by the smell. So is the gas that is used for lighting houses and other buildings. Either of these gases could produce death by suffocation. Whenever an unpleasant odor is detected in the air, it will always be safe to thoroughly air the room or building, or leave the place. Sometimes cesspools or drains poison the air so completely that fevers are caused in consequence.

18. **Another Protection.**—The nostrils have another protection against the breathing in of impurities. The little hairs which the nostrils contain catch many particles of dust and many impurities of the air. They catch them and keep them from harming us. This is another reason why we should inhale through the nose. We told you in another chapter of the danger in breathing cold air in through the mouth. The bronchial tubes also contain the tiniest of tiny hairs, and for a similar purpose to that of the hairs in the nostrils. They catch many particles of dust, as we have had proof many times upon clearing the throat and lungs after having inhaled smoke or fine dust in a railway car.

19. **Moisture in the Breath.** — On a very cold morning, when we are walking fast or running, we notice a vapor, like steam, coming from our mouths.

A lady's veil or a man's mustache will often be covered with this vapor, frozen and looking like little particles of ice. The window-panes in our rooms, in very cold weather, are sometimes covered with the pretty frostwork that children admire. We notice it more when a room has been tightly closed during the night.

20. This appearance is caused by the air that is breathed from our lungs. It shows that the air we send out from our lungs contains water, which was not in the air we breathed into them. In hot weather we cannot notice this moisture unless we breathe upon a looking-glass or some other polished surface; then we shall see that the object we have breathed upon is dim and feels wet.

21. **Carbon and Oxygen.**—If we are all the while breathing out carbonic-acid gas, and all the people in all the cities and large towns as well as in the country are doing the same, how does it happen that there is any pure air left for us to breathe? Remember also that not only men, women, and children, but all animals, even little birds, fishes, and worms, need the oxygen of the air. Our fires and lights consume much more. Why has not all the oxygen been used up long ago? Where does the

needed supply come from? and what becomes of the carbonic-acid gas?

22. It has been said that we breathe through the pores of the skin as well as through the lungs. We do not think of that, however, when we speak of breathing; we think simply of the lungs. Plants breathe through tiny holes in their leaves, and they do *not* need *oxygen*. They need carbonic-acid gas as much as we need to dispose of it. Can you now answer the question, "What becomes of the carbonic-acid gas?"

23. **What Plants Breathe.**—This separation of the carbon from the oxygen is what the trees, grass, and plants are doing with the carbonic-acid gas. They take up the carbon from the impure air and leave the oxygen. Carbonic-acid gas contains the true food for the vegetable world. The carbon is retained and used,—it enters into fruits, grains, and eatable roots,—while the oxygen is given back for the nourishment of the animal world. Nothing is wasted. What a wonderful plan is this for purifying the air! We breathe out carbonic-acid gas, which the plants need. We need oxygen, which the plants separate from the carbonic acid and give back to us.

24. **City Air.**—How is city air purified? It is

purified partly by the wind. There is not enough vegetation in cities to use up the carbonic-acid gas, but the winds blow the city air to the country and to the ocean, and the air of the country and of the ocean is blown back to the city. Also, the rain in falling washes out some of the impurities in the air. This is a good reason for disconnecting, in the beginning of a shower of rain, the pipes that carry water from the roofs of buildings to cisterns, and connecting them a little while later, after the air is purified. It is also a good reason why it is not safe to eat snow.

25. **Ventilation.** — The subject of ventilation, which means a plan by which impure air can escape from a room and pure air enter, is an important one. If we would keep our heads clear and our bodies in health we must have sufficient oxygen to breathe. The air in lecture-rooms, public buildings, churches, schoolhouses, and our own homes should be pure, and there are excellent methods by which it can be made and kept so. We can attend to the matter of ventilation in our homes, if we can do no more; and in this way we may avoid many and serious lung troubles.

26. If there are two openings in a room, one for the escape of impure air and the other for the admis-

sion of pure air, and if the openings are large enough, the ventilation will be good. A door and a window, each opening into the outer air, will ordinarily ventilate a small apartment; or a window alone will answer, if it is open both above and below, and the open space at each end is not less than one inch for each person in the room, when the window is about a yard wide (Fig. 40). The impure heated air rises. A "draught" is never necessary to good ventilation. The temperature of the air admitted may be warm or cold. It is thought by many that if the air is cold it is pure; but this is an error, for cold air will receive and keep the same impurities as warm air.

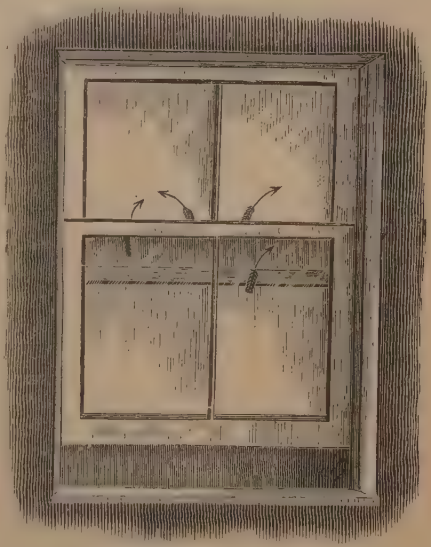


FIG. 40.—SHOWING MANNER OF VENTILATING BY INSERTING STRIP OF WOOD BENEATH LOWER SASH OF WINDOW.

27. Shall we open our bedrooms to the night air? Florence Nightingale says that night air is the only air that we can then breathe: "The choice is between pure air without and impure air within. An open window, most nights in the year, can hurt no one. In great cities night air is the best and purest to be had in the twenty-four hours. I could better understand, in towns, shutting the windows during the day than during the night."

28. **Tobacco.**—Tobacco, by its effect upon the linings of the nose, mouth, throat, and lungs, causes great discomfort, at times, not alone to the one who is using it, but to those who are obliged to breathe the smoke of tobacco. It dries the throat so that the voice becomes husky, it produces coughing, and it is quite impossible to sing in an atmosphere which contains tobacco-smoke. The habit of swallowing tobacco-smoke is injurious because it irritates the delicate lining of the bronchial tubes.

29. **Alcohol.**—Alcohol, in weakening the blood-vessels, weakens the lungs, because they are in such peculiarly close relation to the blood-vessels. You will remember that the exchange of gases takes place in the lungs through the walls of the air-cells and those of the blood-vessels. The breath of one who has taken any alcoholic liquor into his stomach

is tainted by it. The kind of liquor taken can often be told by the smell of his breath. The air coming

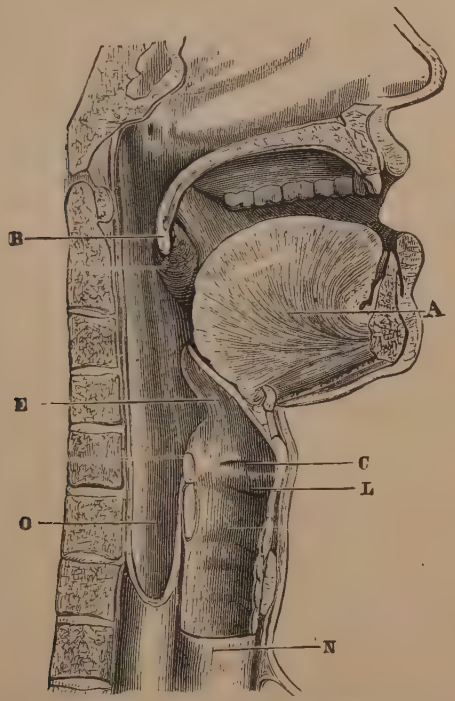


FIG. 41.—SECTION OF THE MOUTH AND THROAT.

A, The Tongue. C, Vocal Cord. L, Larynx.
B, The Palate. E, Epiglottis. N, Trachea.
O, Œsophagus.

from his lungs contains an additional impurity. He should be very careful not to breathe into any one's

face, but particularly should he avoid breathing into a baby's face.

30. Men who are preparing for a test of strength or skill in athletic sports, rowing for instance, are not allowed to touch a drop of anything containing alcohol, and they are absolutely forbidden to smoke. T. W. Higginson said this is one reason why he is in favor of athletic sports in colleges. Why are the men denied alcohol and tobacco? Because their trainers know, and they know, that it really weakens them. Their hearts are not as strong on account of it, and that fact alone interferes with their breathing. They cannot control their breathing when alcohol is in their blood as they can when the blood is free from it.

QUESTIONS ON CHAPTER XI

1. What is more necessary to the body than food or drink?
2. What effect has it upon the body? Upon the blood?
3. What are the lungs? Describe them.
4. How does air enter the lungs?
5. Describe the trachea.
6. What is the larynx?
7. Of what use are the vocal cords?
8. What is the epiglottis? What is its use?
9. What are the bronchial tubes?
10. Where are the air-cells?
11. Of what do the lungs consist?
12. What is inspiration? Expiration? Respiration?

13. What is the diaphragm?

14. When does it become almost flat? When does it become domelike?

15. How often do we breathe?

16. How is the breathing affected by the rapid beating of the heart? When do we become "out of breath"?

17. Can we control our breathing for a short time? How long can the breath be held?

18. When might this power be of use to us?

19. Of what is air composed? In what parts?

20. Who discovered the different parts of air?

21. What happens to air when it is taken into the lungs?

22. How often must we have air? Food?

23. Could liquids pass from the blood-vessels to the air-cells?

24. What odor has pure air?

25. How is it easy to "catch" some diseases?

26. Give two reasons why a sick-room should be ventilated.

27. What protection have we against breathing impure air?

28. What should be done when we detect any unpleasant odor?

29. What poisonous odors may cause fevers?

30. What second protection have we against the breathing in of impurities?

31. Give two reasons for inhaling through the nose.

32. What proofs have we that there is moisture in the air which we exhale?

33. How do plants breathe? What do they *need* to breathe?

34. How is the air in the country purified?

35. How is city air purified?

36. Why is it a good plan in the beginning of a shower to disconnect pipes that carry water from roofs of buildings to cisterns?

37. What does *ventilation* mean?

38. Why do we need fresh air?

39. How may we avoid many serious lung troubles?

40. Tell how a room may be ventilated.
41. Who was Florence Nightingale?
42. How does tobacco injure the throat?
43. Why is it injurious to swallow tobacco-smoke?
44. Why does alcohol weaken the lungs?
45. How does the exchange of gases take place in the lungs?
46. How does alcohol affect the breath?
47. What men are never allowed to use a drop of any liquor containing alcohol? Why?
48. What effect has it upon their power to control their breathing?

CHAPTER XII

THE NERVOUS SYSTEM

1. **Growing Powers.**—We have been studying about *digestion, circulation, and respiration*, which are common to vegetables, animals, and human beings. These are growing powers. As the body is nourished by the blood which circulates to all its parts, giving to each organ what it needs, so the trees and plants, by their roots, stems, and trunks, convey a fluid called *sap* through all their parts. This sap does for them what the blood does for our bodies. In other words, it causes their growth and nourishes them. Besides this, the leaves, which may be called the lungs of the plant, take from the air a gas which is hurtful to man, but which is necessary to the life of the plant.

2. **The Nerves.**—We, as well as all animals, have, in addition to these growing powers, organs by which we know what is going on around us; what to do for our own pleasure and, better yet, for the pleasure of others; how to avoid certain danger-

and to help others avoid them; but more wonderful still, they give us the power of reason. We may be glad to live, to breathe, to eat, to sleep, and to move; but the power to *think* is a constant joy. In this respect human beings are far superior to plants and animals.

3. We are told that

> "The flowers in their perfume
> Ask sweetness of you;
> A love that is tender,
> A life that is true."

Although flowers cannot speak, because they have not the power of thought, they certainly do influence us. Animals possess remarkable intelligence, and when we wish to tell how much they know we say "they can almost speak." The organs that give us the power of feeling, motion, and thought are the *nerves*.

4. **The Nervous System.**—The nerves are divided into two classes or systems: those that control the *voluntary* motions of the body, and those that control the *involuntary* motions. The voluntary motions such as walking, eating, and thinking are controlled by the *brain* in the head, the *spinal cord* in the backbone, and some of the nerves branching off from them. This system is called the *cerebro-spinal* system

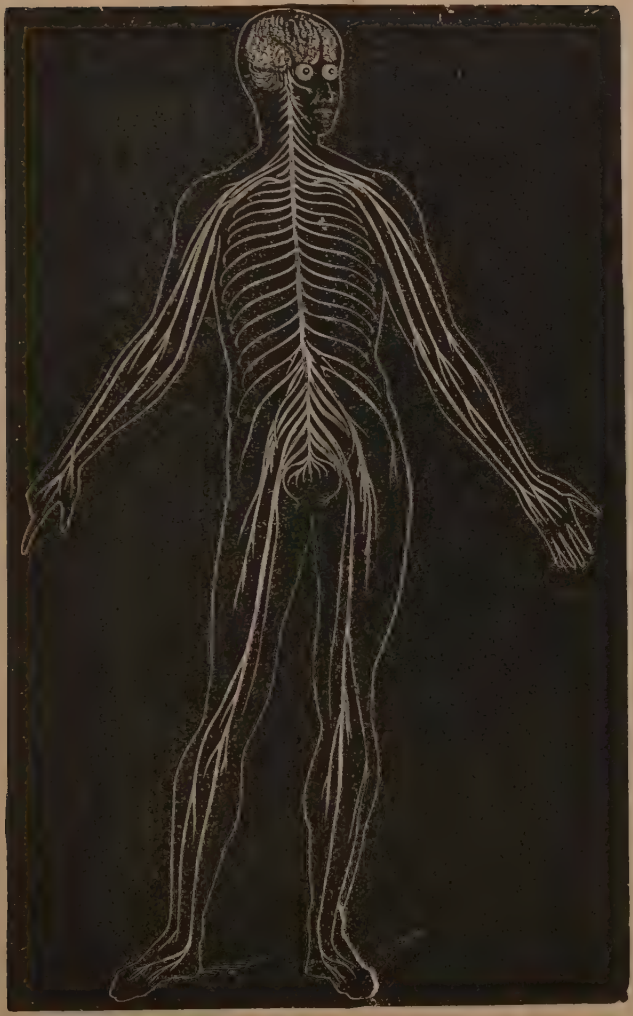


FIG. 42.—THE CEREBRO-SPINAL SYSTEM.

The involuntary motions concerned in the processes of digestion, of circulation, and of respiration are known as the *sympathetic* system of nerves. These two systems form the entire *nervous system*. The nerves are also divided into two other classes; and they are called *nerves* of *sensation* and *nerves* of *motion*. The nerves of sensation communicate with the spinal cord or the brain for advice or direction; and the nerves of motion carry back the reply.

5. **The Brain.**—The brain is one of the most important and useful organs in our body. It fills the great cavity of the skull; it is egg-shaped, and it is divided into two parts—the *cerebrum*, or large brain, and the *cerebellum*, or small brain (Figs. 45 and 50). It is a curious, whitish, pulpy-looking substance, marked all over in wavy furrows, about an inch deep, looking something like a cloth that has been squeezed in the hand.

6. It weighs about three pounds, or nearly fifty ounces, in a grown person, although some brains weigh much more. The brains of Daniel Webster and Agassiz each weighed fifty-three and a half ounces. These are among the largest brains of which the weight is known. A large brain is thought to be the sign of a great mind; but the quality, as well as the size, must be considered. The

brain of an idiot does not often weigh more than thirty ounces.

7. **The Cerebrum** (Fig. 43).—The cerebrum, or brain proper, fills up the top and front of the skull and is very much larger than the cerebellum, or "little brain." A deep groove divides it lengthwise into two equal parts called *hemispheres*. The outside is marked all over with winding, irregular furrows, as has been said. It is gray in color,

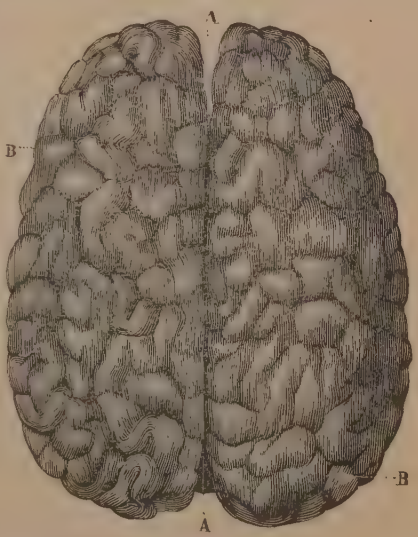


Fig. 43.—Upper Surface of the Cerebrum.
A, Longitudinal Fissure.
B, The Hemispheres.

and contains nerve-cells, as well as a great many blood-vessels. This gray matter, which is about a fifth of an inch thick, goes down into all the furrows. On that account there is much more of it than if it covered only the top of the brain as a smooth surface. The interior of the brain is composed almost

entirely of a white substance made up of nerve-fibers (Fig. 44).

8. **The Cerebellum.**—The little brain is divided, like the cerebrum, into two parts. The surface is composed of the gray matter, and the interior of the white matter. It is again divided by many ridges which run parallel to each other, and which go down deeply into the white matter, looking somewhat like

Fig. 44.—Lower Surface of the Brain.
The numbers refer to the pairs of nerves.

the trunk and branches of a tree. The cerebellum is about one eighth the size of the large brain (Fig. 45).

9. **The Medulla Oblongata.**—From the front part

of the little brain, and from the under part of the brain proper, proceeds a collection of fibers or little cords, which are all joined together and go into the spinal column. This is called the *medulla oblongata* (Fig. 45). At the base of the brain and above the place where the cord enters the spinal column are twelve pairs of nerves (Fig. 44). These nerves are round cords of a glistening white appearance, and are well protected from injury.

10. When the cord enters the spinal column it is called the *spinal cord* or the *spinal marrow*. It is contained in the holes which, as we have seen, make a tunnel down the backbone of the skeleton. The gray and the white matter in the spinal cord is the same as the gray and the white matter found in the brain, and its

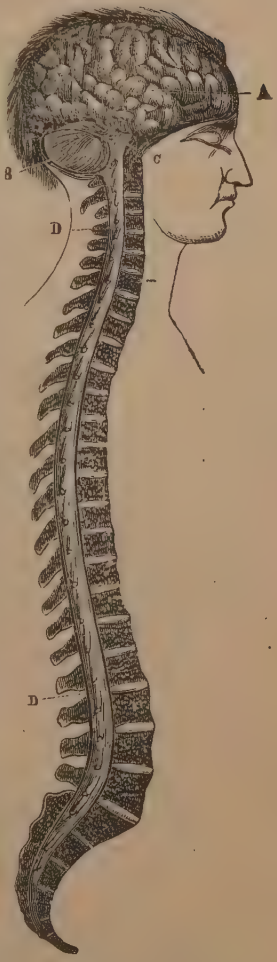


FIG. 45.—C, MEDULLA OBLONGATA.
A, Cerebrum; B, Cerebellum; D, D, Spinal Cord.

substance is so soft that it needs protection along the whole of its course. Accordingly we find that the bones are so arranged as to shield this substance from injury in the same way as the brain is protected by the skull.

11. **Arrangement of Spinal Nerves.**—The spinal nerves, thirty-one pairs in number (Fig. 46), spring from each side of the cord by two roots, an *anterior* or front, and a *posterior* or back root. From these

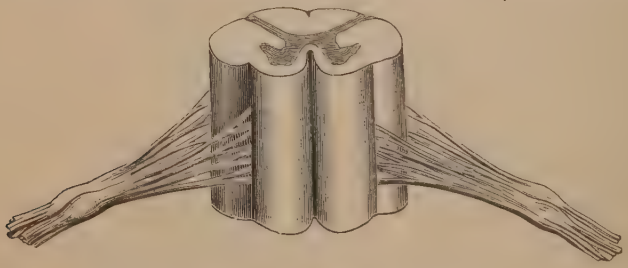


Fig. 46.—Section of Spinal Cord, with Roots of Spinal Nerves.

spinal nerves other nerves branch out, growing smaller and smaller, to the most remote parts of the body. Athough where these nerves end they are finer than a hair and there are so many of them that they never have been counted, it is likely that each one goes from its origin in the brain or elsewhere directly to the part it is intended to protect, because we always locate or feel the pain in the part which

has been injured. The message is never carried incorrectly.

12. **The Sympathetic System.**—The nerves of the sympathetic system control the action of the stomach, intestines, heart, blood-vessels, lungs, and some other organs. This unconscious action of the nerves branching from the spinal cord is known as the *reflex action* of the cord.

13. **The Uses of Reflex Action.**—Reflex action is important in both our sleeping and our waking hours. It is an unseen protector, never weary and never needing sleep. It watches over us when our brains need rest, and keeps us from danger or death. The work of digestion is constantly going on though we never think of it; our hearts are beating while we are asleep as well as while we are awake; and we breathe without troubling ourselves about it. All these movements are caused by reflex action, and our brain is thus saved a vast amount of work. If we had to think about all these things, we should soon be tired of life, or we should forget them and should die. Our brains could have no rest, for we could never sleep. We should always have to be on the watch to keep our bodies alive.

14. **The Health of the Nervous System.**—We cannot prize too highly the powers given to us by the

nerves. Since we receive through them such wonderful things, is there not something we can do for them? Can we selfishly accept their gifts and deny them what they need? It is not possible. We can prove our right to them by the care we take of them. The body is a wonderful possession, and the nervous system is its most wonderful part.

15. The body needs food and drink for its nourishment: then the nerves, being a part of the body, need nourishment. Every nerve, even the smallest, needs nourishment. Even the nerves of the teeth need it as well as all other nerves. We know what kinds of food and drink are best suited to give health and strength to the body; so we know one way in which we can make some return to the nerves: we can feed them well.

16. The body needs oxygen: then the nerves need oxygen. We are doing them an injury when we remain in poorly-ventilated rooms. Nothing is better for the nerves than healthful exercise in the open air. It gives brightness to the eye, color to the skin, freshness to the entire system, and cheerfulness of spirit, that nothing else can give, and the nerves of the eye, skin, bones, muscles, and brain are strengthened in consequence. Whatever strengthens any part of the body strengthens the nerves of that

part. Whatever weakens any part of the body weakens the nerves of that part.

17. **We Need Sleep.**—During sleep the process of nourishing the body, of supplying material for growth, of resting the spinal column, of resting and strengthening the nervous system, is carried out most completely. When we sit up late at night we are "burning our candle at both ends," as the saying is; because we lose more strength, of both body and nerves, than we would lose otherwise, and we allow less time in which to make up this loss.

18. Grown people need from eight to ten hours of sleep each night, and young people need even more. And here we should like to enter a plea for single beds. Two comfortable single beds need not take up much more room than one double bed; but the comfort and health afforded by the single beds cannot be measured. It is never wise for children to sleep with elderly people.

19. **Conditions affecting the Nerves.**—In addition to food, oxygen, and sleep, the nerves need many other things. To be hungry, to breathe impure air, to go without sleep, will make people restless and irritable. To be well fed, to breathe pure air, to have sufficient sleep, will or *should* make people happier and more helpful.

Among other things that help to keep the nervous system healthy are cheerfulness, temperance, the love of music, pictures and flowers, good reading and industry, and loving thoughts for our family and friends.

20. Cheerfulness rests the one who possesses it, and all the people about him. Temperance in eating, drinking, working, playing,—in short, temperance in all things,—is necessary for nervous strength. The love of anything beautiful, whether it appeals to the ear, eye, or mind, is equally necessary.

We know of no better way to keep the nerves well and strong than to have such loving, friendly thoughts of those around us that we cannot wrong them in deed or word or thought, and that for their happiness, as well as for our own, we will take the most intelligent care of our bodies and our nervous systems.

21. **Opium.**—Opium is the thickened juice of the poppy-plant (Fig. 47) of India, and forms the chief ingredient of the soothing syrups, laudanum, and paregoric. The effect of opium upon the nerves is particularly injurious, and it should never be used except under the direction of a competent physician. The use of opium for relieving pain has been known for hundreds of years; but the danger in it

is very great. An overdose would produce death, and small doses are never safe. It weakens the body and mind, and it has a decidedly injurious effect upon that part of the mind known as the "will." Never take any drug to produce sleep or to suddenly relieve a headache, unless your physician advises it. Sometimes headaches produced by nervous excitement are cured by powders or liquids that deaden the nerve-power or cause the heart to beat more slowly. This is always dangerous.

FIG. 47.—THE POPPY-PLANT.

22. **TOBACCO.**—Tobacco injures the entire nervous system. "Tobacco is never necessary; it is always hurtful to boys and young men, to weak people and those disposed to consumption." The use of tobacco in the United States Naval and Military Academies is forbidden on the ground that it is attended with serious damage to health. The nerves are weakened by it, and the hand in particular lacks steadiness on that account. A teacher of drawing,

of fourteen years' experience, has said that he can always tell from the character of the lines in the drawing whether or not the pupils use tobacco.

23. **Alcohol.**—Very serious changes in the brain result from the constant use of alcohol. The brain becomes harder and tougher than is natural, certain parts of it grow smaller, the blood-vessels become weakened, and serious brain diseases result. Alcohol produces also a kind of insanity. This is indicated by loss of memory, inability to reason, a lack of judgment, and peculiar ideas regarding truth and justice, right and wrong conduct. If alcohol is used constantly it causes a thirst for strong drink that knows no bounds and is very rarely cured: this is called thirst-madness.

The direct result of taking alcohol is seen in the loss of self-control. There is the possibility of losing the nerve-power at any time when one has contracted the habit of drink. The habitual use of alcohol is positive injury to the intelligence, strength of mind, and moral character. If you never become a victim to the habit of drink you will never have cause to feel that your sons or daughters have been unable to resist its influence because they inherited from you a taste for it.

QUESTIONS ON CHAPTER XII

1. What are growing powers?
2. What fluid carries nourishment to all parts of plants and trees?
3. In what respect are human beings superior to plants and animals?
4. Repeat the stanza about the flowers.
5. How do we sometimes describe the intelligence of animals?
6. What organs give us the power of feeling, motion, and thought?
7. What are the two systems or classes of nerves? Describe them.
8. Of what does the nervous system consist?
9. Into what other two classes are the nerves divided?
10. Describe the brain.
11. What is its weight?
12. What and where is the cerebrum?
13. What is the color of the substance of the outside of the cerebrum? The inside?
14. Where and what is the cerebellum?
15. Of what is it composed?
16. How does the cerebellum compare in size with the cerebrum?
17. What is the medulla oblongata?
18. What are the nerves like that are given off in the brain?
19. What is meant by the spinal cord?
20. How many pairs of spinal nerves are there?
21. To what parts of the body are nerves carried?
22. What does the sympathetic system of nerves control?
23. What is meant by the reflex action of the spinal cord?
24. What are its uses?
25. What is the most wonderful part of the body?
26. How do we know that the nerves need nourishment? Do all nerves need it?
27. How do we know that the nerves need oxygen?

28. What effect is produced upon the nerves by exercise in the open air?

29. Repeat the last two sentences in paragraph 16.

30. What is carried out most completely in sleep?

31. When do we "burn our candle at both ends"? Wny?

32. How much sleep do young people need?

33. Why should single beds be used?

34. Should children sleep with elderly people?

35. What will make people irritable?

36. What should make them happy and useful?

37. Mention several things that contribute to the health of the nervous system.

38. In what should we be temperate?

39. What can you say of anything beautiful?

40. What is a most excellent way in which to keep the nerves well and strong?

41. Why should we take good care of the nervous system?

42. How, and how only, should opium be used?

43. How long have people known of its power to relieve pain?

44. What is the danger of an overdose?

45. In what way is opium injurious?

46. What advice is given regarding drugs? What is always dangerous?

47. What effect has tobacco upon the entire nervous system?

48. To whom is it always hurtful?

49. Where is its use forbidden? Why?

50. What has been the experience of a drawing-teacher?

51. What effect has alcohol upon the brain?

52. What are some of the indications of insanity produced by alcohol?

53. What is thirst-madness?

54. What direct result of taking alcohol is seen?

55. To what is the habitual use of alcohol a positive injury?

56. From what danger may you save your sons and daughters if you never form the habit of drink?

CHAPTER XIII

THE SPECIAL SENSES

1. **The Brain is the Organ of Sensation.**—We have learned that the nerves, going from the brain to the fingers, toes, and to the surface of the body generally, give us the sense of feeling, or *sensation*, in those parts. If a nerve ending in the skin should be cut, so that it could not convey messages to the brain, we might be pinched or pricked with a pin over the point served by that nerve without feeling pain. We say that we feel with our fingers, we hear with our ears, we taste with our tongues; the truth is, however, that without the brain we should have no knowledge of these things. It is the brain that feels, tastes, smells, sees, and hears.

2. **Sensation.**—The sensibility or feeling in any part of the body depends upon the number of nerves the part contains. The nails, the hair, and the scarf-skin have no nerves, so that they may be cut without giving us pain. The cutis, or true skin, which is, as we have learned, under the scarf-skin, is very sensi-

tive, because it is full of nerves; but the muscles, cartilage, and bone have very little feeling. When any one is under the influence of laughing-gas, ether, or chloroform, a tooth can be drawn, a finger taken off, a broken bone can be set, without causing pain. Why? Not because there are no nerves in the tooth, finger, or flesh about the broken bone, but because the brain is put to sleep or made to lose its knowledge of sensation. The different parts send their messages to the brain as usual, but it cannot receive them; consequently no pain or sensation is felt.

3. **The Uses of Pain.**—We all know what pain is, for we have felt it. Grown persons, as well as boys and girls, often get impatient because they have to bear it. Have we ever thought that pain, although so hard to bear, has its uses? It acts as a protection to the body. If we hold the hand too near the fire, the pain we feel warns us to take it away at once. If it were not for the sense of pain, the hand might be kept there until it was severely burned, and we should not know it. Pain also warns us not to eat food that we cannot digest. If we do not heed the warning, we deserve to suffer. Persons stupefied by drink are often severely burned, or even burned to death, while under its influence.

4. **Special Senses.**—Besides the feeling of pain just described, and which is common to all parts of the body, there are other feelings which are called *special senses*. There are five of them—touch, taste, smell, sight, and hearing. Special organs are furnished for them: the hands for touching, the tongue for tasting, the nose for smelling, the eye for seeing, and the ear for hearing. No one of these organs can do anything but its own work.

5. **Touch.**—The sense of touch is given to the whole surface of the body, but is most delicate in the hands, and particularly in the tips of the fingers. If we pass our fingers over an object, even if we do not see it, we have an idea at once of its size, shape, and form, and could tell it by the touch at any other time. In the blind this sense of touch is often educated to such a degree that it almost takes the place of sight. They can read by passing the fingers rapidly over raised letters, and by feeling a face will know it again, as well as we do by seeing it.

6. The blind are almost always very gentle, patient, and painstaking. They study reading, spelling, geography, arithmetic, and many other branches of learning, as you do, but with vastly more work. We once saw a little girl in the blind asylum at South Boston, Mass., perform an example

in compound numbers; and she did it almost as quickly as we could have done it ourselves. The figures that she used were all at the top of her arithmetic-frame, and she could tell by feeling them when she had the right ones to bring down.

7 Dr. Samuel G. Howe was at the head of that institution for many years. It is a pleasure to mention his name. What he did for Laura Bridgman has made the whole world his debtor. Laura Bridgman could not see, hear, or speak; yet Dr. Howe taught her how to express her thoughts, and how to learn the thoughts of others. He did this entirely through the sense of touch. Helen Kellar has been taught in the same manner and at the same institution.

8. The sense of touch is almost always correct,

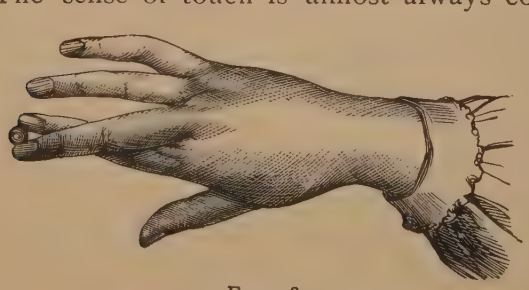


FIG. 48.

but it is sometimes misleading. If we cross the first two fingers of one hand and then roll a marble or

some small object with the tips of them (see Fig. 48), it will seem as if two marbles are being rolled. If the fingers crossed in this way are applied to the end of the tongue, two tongues will seem to be felt.

9. **The Organ of Taste.**—The tongue is the special organ of taste, but the back of the mouth also possesses this sense. The tongue has a variety of muscles. It can move in almost any direction. Laura Bridgman used to thread her needle with her tongue.

If you will look at your tongue in a mirror you will see that it is rough. This roughness is caused by tiny raised spots which contain the nerves of taste. By means of these we can taste and feel different substances, and we can tell their temperature also.

10. **The Education of the Taste.**—Our natural tastes are simple. A child is satisfied with his plain, wholesome diet until he knows it is possible for him to have other food. Can you not remember having seen babies or very young children show by the faces they made that they did not like certain kinds of food when they first tasted them? They can learn to like almost anything, however.

11. Natives of cold countries depend largely upon fats and oils as a nourishing and necessary diet.

People traveling in those countries, although wholly unacquainted with such a diet, grow to like it very much as they become used to it. The chief use of the sense of taste appears to be as a guide in the selection of proper food. The sense of taste can be very finely cultivated, as is shown by those who become professional "tasters" of tea.

12. **The Nose.**—The sense of smell is due to the nerves that end in the delicate membrane, or internal skin, that lines the openings or cavities of the nose (Fig. 49). The nose is formed partly of bone and partly of cartilage, or gristle, together with this covering membrane. The upper part of the nose is joined to the skull by a few small bones. The lower part or tip of the nose contains several thin pieces of cartilage which enable it to bear heavy blows without breaking. Behind the nose, in the upper and back part of the mouth, are two cavities called the nasal cavities. These have a delicate lining called the mucous

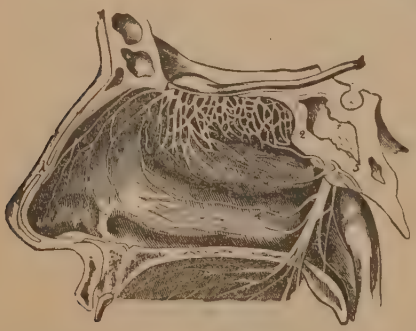


Fig. 49.—Section of the Right Nasal Cavity.

membrane, which is kept moist by a fluid which it, in common with all mucous membranes, secretes. When we suffer from a cold in the head this membrane becomes dry and small, and the sense of smell is almost destroyed.

13. **Why we Smell.**—The perfume of a flower or other substance is caused by tiny particles of it. A flower does not melt as snow and ice do, nor does it dissolve as sugar does; but a flower is constantly giving to the air parts of itself too small for us to see, but large enough for us to smell when we inhale them with the air through the nose. They touch the nerves of smell within the nose, and that is why we smell them.

14. **The Sense of Smell.**—The sense of smell is more acute in some persons than in others. Some persons upon entering a room in which there are flowers know instantly what the flowers are by their perfume. Upon entering a room in which a person is ill a physician can sometimes tell the nature of the illness by the odor detected about the patient. Dogs possess the sense of smell in a very high degree, and it can be cultivated so as to be very useful.

15. **Uses of Smell.**—Deer and other animals, when they are hunted by dogs, sometimes put their pur-

suers off the scent by going into a stream of water, and following the stream for a long distance. They appear to know that the hounds will be unable to scent their course in running water, and how far they must keep in the stream before it is safe to take to the woods again. Smell, like taste, helps us to select proper food and to avoid that which is spoiled and unfit to be eaten. It also warns us not to breathe gases and vapors that are unfit to be taken into the lungs, and which we might breathe did not the sense of smell warn us to avoid them.

16. **Sight.**—*Sight* is the special sense by which we know the color, form, size, and other properties of bodies. Touch, taste, and smell bring us in direct contact with the bodies which we perceive through those senses. With sight it is different. The objects made known to us through the eye should be removed from it a few inches at least. The power of sight is so wonderfully perfect, however, that we can see with equal ease objects only a few inches away, as well as those so far removed that the distance cannot be calculated. While we should not overlook the wonders and beauties immediately near us, one of the most inspiring uses of sight is its employment in the study of the stars.

17. **The Eye.**—The eye is the organ of sight. The

closeness of the eye to the brain and the important part it performs in giving expression to the feelings, such as sympathy, friendliness, and affection, have given it the name of "the window of the soul."

FIG. 50.—BRAIN AND EYEBALL.

The expression of a person's eye is often more to be trusted or distrusted than his words or tone. By a wonderful provision of the same Mind that planned every part of the body we are given two eyes. It not unfrequently happens that one eye may be injured or lose its sight entirely, while the other will remain well and strong.

18. **THE EYEBALL.**—The eyeball, which is a delicate organ, is well protected from injury by bony

sockets or holes in the head. If you place over the eye a book one end of which rests on the eyebrows, it will be found that no part of the eye is touched. The bones project so as to protect it. The eyeball is round, except on the front, which projects beyond the rest (Fig. 51). Joined to the

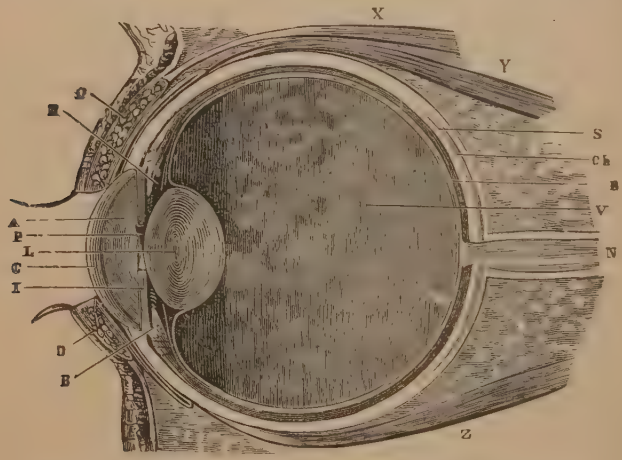


FIG. 51.—VERTICAL SECTION OF THE EYE. (Enlarged.)

C, The Cornea.
I, The Iris.
P, The Pupil.
L, The Crystalline Lens.
R, The Retina.
N, The Optic Nerve.
DD, The Eyelids.

back of the eyeball, as the stem is joined to the apple, is the optic nerve.

19. **THE RETINA.**—The optic nerve spreads over the inner surface of the eye, and is called the *retina.*

Upon this, pictures of objects looked at are thrown, and remain for a few seconds, but gradually fade away. A bright light or color looked at for a few minutes cannot be lost sight of at once by closing the eyes. You seem to see it dimly, but in the same form as when your eyes were open. After a little time it fades away. The spokes of a rapidly-moving carriage-wheel look like a plane surface; a stick lighted at one end and whirled rapidly around, in the dark, looks like a ring of fire.

Some persons cannot tell one color from another. When they cannot do so they are said to be "color-blind."

It is so important that engineers of railroad trains should not be color-blind that their sight is examined before they are given positions.

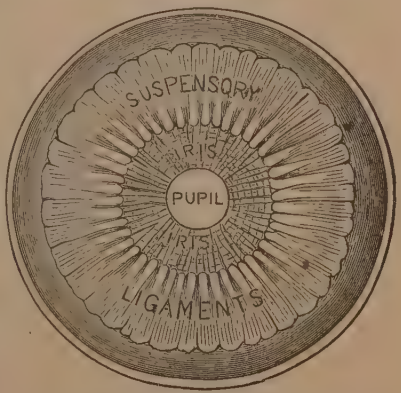


FIG. 52.—FRONT SECTION OF THE EYE-BALL, VIEWED FROM BEHIND, AND SHOWING SUSPENSORY LIGAMENT, IRIS, AND PUPIL.

20. **THE IRIS AND PUPIL.**—The thin circular curtain that gives to the eye its color—blue, brown, gray, or black—is called the *iris* (Fig. 52). In the centre of

the iris is a round opening called the *pupil.* This grows larger or smaller as we are in a dark or a light room. When we go from a very light to a dark room we can see nothing plainly, but as the pupil expands, or grows larger, more light enters the eye, and we begin to see objects more distinctly.

21. **The Cornea.**—The front part of the eyeball projects somewhat and has for its protection a transparent substance in shape like a watch-crystal. This is called the *cornea*, and is the sole window by which light enters the eye. In health the *cornea* is beautifully clear and bright, and so thin and delicate that, looking straight at it in a mirror, you cannot see it in your own eye. But if a person stand with the side of his face towards you and you look closely at his eye, you can see this little bulging window-pane.

22. **Shape of Cornea, and Sight.**—The cornea may bulge too much. You will see this in some people who, when reading a book, find it necessary to hold it very much closer to the eye than you do. This is because of the too great bulge of the cornea, and is one of the causes of *near-sightedness.* On the other hand, if the cornea is too flat, objects that are held close to the eye are not seen clearly. A person

is then said to be far-sighted. In either of these cases eye-glasses ought to be used, even for young children.

23. **The Crystalline Lens** (Fig. 51).—Across the front of the eye, just behind the iris, is something which looks like a small lemon-drop; it is about a quarter of an inch thick, and is called the *crystalline lens*. If you will place a magnifying-glass at a window of a darkened room and hold a piece of paper behind it, you will see upon the paper a picture of what is going on outside, but the images in the picture will be inverted, or upside down (Fig. 53). People will

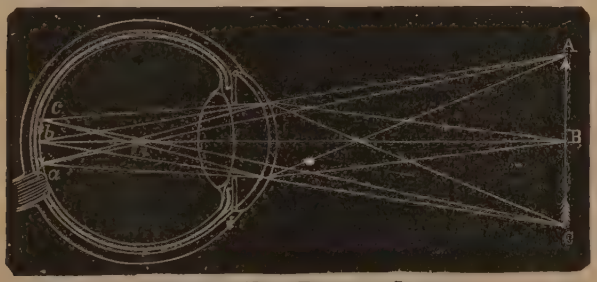


Fig. 53.—The Retinal Image.

be seen to be walking with their heads down and their feet up, and houses will seem to be hanging from the ground above them, instead of standing on it. This is called an inverted image of the objects you see. In the same way the rays of light pass

through the crystalline lens, and are brought together in a point called the *focus*, at the surface of the retina, and form an inverted picture there.

24. **The Inverted Image.**—You will ask, If the image on the retina is inverted, how does it happen that our mind sees it in its right position? That is a question to which there is no satisfactory answer. It may be that, as we know our own place upon the ground and as we stand upright, we learn to know what is the real position of objects, and thus give them their true place.

25. **The Eyebrows and Eyelids.**—The hairy arches just above the eyes, which prevent the perspiration from running into them and protect them from dust, are the *eyebrows*. The movable curtains which, when shut, cover the eye entirely are the *eyelids*. The upper lid is larger and more easily moved than the lower one. A firm mucous membrane lines the eyelids, and is so sensitive that the smallest bit of sand or dirt in the eye causes a flow of tears and a great deal of pain until it is removed.

26. **The Eyelashes.**—The hairs which are on the edge of the eyelids, and which with the eyelids help to protect the eye from dust and other things that would injure it, are the *eyelashes*. The lashes also help to regulate the quantity of light that enters

the eye. Close to the lashes there are little glands which furnish an oil that prevents the lids from sticking together when they are closed in sleep.

27. **The Lachrymal Gland.**—At the upper and outer side of the orbit is a gland from which the tears come, and which is called the *lach-ry-mal gland* (Fig. 54). The tears keep the eyeball moist and clean, because they constantly pass across it. When we get anything in the eye which makes the tears run, we keep blowing the nose. This is because the tears have passed through by a little pipe called the *nasal duct*. The moisture that is not needed for the eyes is carried off by this duct. When we are excited or grieved the tears sometimes overflow the lower eyelid.

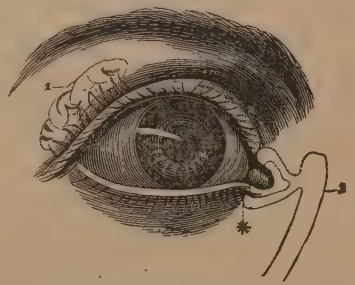


Fig. 54.—Front View of Right Eye. (Natural size.)

1. The Lachrymal or Tear Gland, lying beneath the upper eyelid.
2. The Nasal Duct is shown by the dotted line. The * marks the orifice in the lower lid.

The central black spot is the *pupil;* surrounding it is the *iris*.

28. **Care of the Eyes.**—Many people are very careless in using the eyes. They read or sew without having light enough to see plainly what they are doing. They read too fine print, or read so long

that their eyes become red and painful. They injure their eyes by reading in bed, when they ought to be asleep. We should never read by moonlight or firelight. The light should not shine directly upon the eyes when we are reading or sewing. If a shade is not worn, we should sit with the back to the light so that it falls upon the book or the work, and not upon the eyes. If the eyes begin to pain us, it is best to rest them. By neglecting to do this persons have had trouble with their eyes all their lives, and some have even become blind.

29. **Hearing.**—When we have thrown a stone into smooth water, we have seen a circular wave set in motion from the point where the stone struck the water, and have watched it growing gradually larger. Somewhat like this is the wave of motion in the air. If we strike a bell, the air about it is set in motion. This motion extends to the air beyond it, until at last it reaches the ear and sound is heard. Sound is an impression made upon the ear by the vibration of the air caused by a moving body. Hearing is the special sense by which we are made acquainted with sound.

30. **Solids Convey Sound.**—Solid substances convey sounds more distinctly than they are conveyed by the air. You will find this to be true if you place

your ear at one end of a long beam, and let one of your playmates scratch the other end with a pin. You will hear the scratching very plainly.

The Indians by putting their ears to the ground can hear a troop of horsemen coming, and can tell the difference between their tread and that of a herd of buffaloes, although they are far out of sight.

31. **Air Necessary to Sound.**—Sound cannot be produced when there is no air. If all the air be pumped out of a tube or jar and we try to ring a bell in it, the clapper will move, but we can hear no sound. If the air be let in again, the bell will ring clearly. How thankful we should be that we can see the faces of our friends and hear their voices! If both sight and hearing were taken from us, how great would be our loss!

32. **The Ear.**—In order to study the organ of hearing, it is necessary to divide the ear into three parts —the outer, the middle, and the inner ear (Fig. 55). The *outer ear* is the part we see. It is a beautifully formed plate of cartilage covered with skin, and is somewhat trumpet-shaped, so that it can collect sounds and direct them inward. There is a little tube an inch and a quarter long, which connects the outer with the middle ear, and across the lower end of the tube a thin membrane is stretched, like the

head of a drum, which divides the outer from the middle ear.

33. **The Ear-drum.**—This membrane is so thin and delicate that it can be easily broken, and if broken the hearing will be injured. The lining membrane of this tube has little glands, which secrete a yellow,

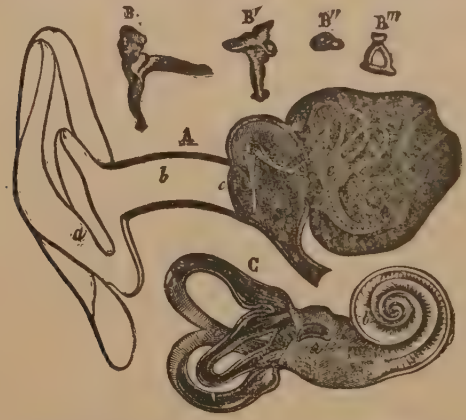


Fig. 55.—The Ear and its Different Parts.
A, Diagram of the Ear.
a, *b*, Outer Ear. *d*, Middle Ear.
c, The Tympanum. *e*, Inner Ear.
B to B''', Bones of the Middle Ear (magnified).
C, The Labyrinth, or Internal Ear (highly magnified).

bitter substance, called "ear-wax," which is a protection against such small insects as are liable to find their way into the outer ear. The middle ear is a small cavity about a quarter of an inch across and half an inch long (Fig. 55). From the peculiar ar

rangement of its different parts it is called the *tympanum*, or drum of the ear. The thin membrane that separates it from the outer ear is the drum-head. This membrane is very thin and elastic, so that every wave of sound that touches it causes it to vibrate, as a drum-head vibrates when it is struck.

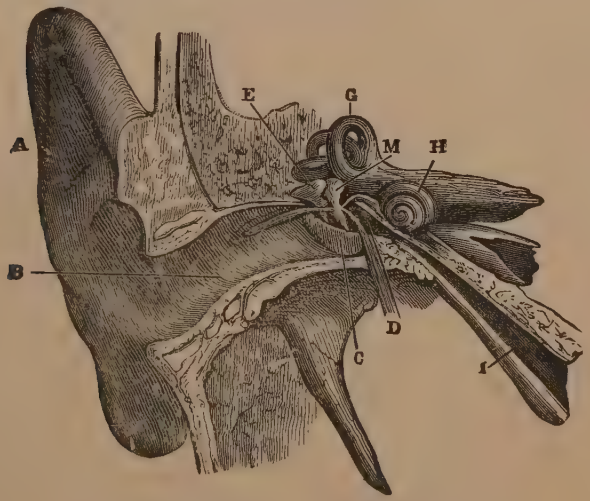


FIG. 56.—SECTION OF THE RIGHT EAR.

A, The Outer Ear.
B, Auditory Canal.
C, Membrane of the Drum (the lower half).
D, A Small Muscle.
E, Incus, or Anvil.
M, Malleus, or Mallet.
I, Eustachian Tube.
G, Semicircular Canals.
H, Cochlea, or Snail's Shell.

34. **THE MIDDLE EAR.**—Within this drum, and stretched across it, are three tiny little bones, the

mallet, anvil, and stirrup. Small as these bones are, they have their muscles, cartilages, and blood-vessels as nicely arranged as are those in the larger bones of the body (Fig. 57). One of these little bones is attached to the drumhead, another to the opposite side of the drum, while the third swings between them. As the waves of sound strike the head of the drum, they move these little bones and cause the motion to be sent forward to the inner ear. The drum contains air, which it receives through an opening or narrow canal called the *Eustachian tube*, which opens into the throat. This tube also carries off the fluids which form in the drum. When the lining membrane of this tube becomes thickened, as it does sometimes when we "take cold" in the head, these fluids may be locked up temporarily, and thus may hinder the waves of sound; when this is the case we are said to be "hard of hearing."

35. **The Internal Ear, or Labyrinth.**—The inner ear is a bony case of tiny, winding chambers and spiral tubes hollowed out in the solid bone. From its winding shape it is called the *labyrinth*. These passages are lined with a delicate bag of membrane, which partly fills the cavity. The bag is filled with and also surrounded by a clear fluid in which it

floats. The fibers of the *auditory nerve*, which passes from the brain to the inner ear, are spread out over the inner surface of this bag. By means of this auditory nerve the impression of sound is made on the brain.

36. **Care of the Ear.**—Great care should be taken of the ear if we wish the hearing to be good. Cold water should never be put into the ear, and if, after bathing, there is water in the ear, we should hold the head to one side, so that the water may run out. Neglect of these directions may lead to deafness. Cold air coming through a crack in the door or window into the ear may cause deafness. If it is necessary to put anything into the ears or to syringe them with water let the water be first warmed. It is dangerous to put cotton into the ears to protect them from cold. The ear is only made more sensitive by it, and the hearing is injured. Never put pins or earpicks or anything made of wood or metal into the ear to get out the wax. All such things are likely to do harm.

37. **To Remove Objects from the Ear.**—If a foreign body, like a pea, a bean, or a little stone, should get into the ear, syringe the ear carefully with warm water, turning the head a little to one side. The overflowing of the water will usually bring it

out. If a fly or some other insect should get into the ear, fill the ear with oil or soap-suds that have first been warmed, in order to kill it. Then turn the side of the head down. The insect and the fluid will usually come out together. If they do not, syringe the ear as mentioned above. It is well to remember this direction, as it may be of service.

38. **Tobacco and Alcohol.**—Tobacco and alcohol are harmful to each of the special senses. The sense

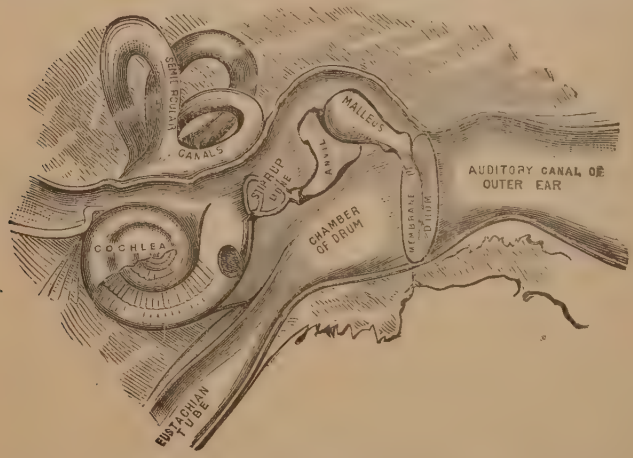


Fig. 57.—Showing the Internal Mechanism of the Ear (greatly enlarged).

of touch is rendered less fine, less susceptible to delicacy in every way, less accurate in the information which it sends to the brain, whenever tobacco

and alcohol are used excessively. Where fine workmanship or the skilled use of the hand is desired, tobacco and alcohol are particularly harmful.

39. **Narcotics and Taste.**—The sense of taste is seriously injured by these two narcotics. The food loses its relish, and many of its delicate flavors are lost entirely by the effect produced upon the taste by these two poisons. As you have already learned, they cause an unnatural thirst which weakens the usefulness of the saliva, and a portion of the taste of food is lost in that way.

40. **Tobacco and Sense of Smell.**—The sense of smell is permanently injured by the use of tobacco. People may say, or they may think, that they can appreciate as delicate odors after the lining of the nose has been injured by tobacco-smoke as they could before; but such is not the case. It is positively harmful to force tobacco-smoke through the nose. It dries the lining of the nose, irritates it, and its ill-effects extend into all of the nasal cavities.

41. **Injury to Hearing and Sight.**—Aside from injuring the special nerves of taste and smell, tobacco frequently produces painful and fatal diseases of the mouth, throat, nose, and ears. Tobacco affects the ears by causing an irritation of the Eustachian tubes. The effect of tobacco and alcohol upon the sight is

much more serious than people generally suppose. Excessive smoking produces at times sudden blindness.

42. **An Instance.**—Not long ago a young man was suddenly stricken blind in one of the principal streets of a large city. The sudden shock and terrible pain occasioned by the loss of his sight caused him to fall to the sidewalk in an unconscious condition. Assistance was summoned, and he was taken to an eye-and-ear hospital, where he received most intelligent treatment by the physicians and surgeons in charge. He was then taken to his home, where the directions for his care were faithfully carried out. Within a week or ten days his sight was restored, but during that period his agony of body and mind was terrible. And all of this suffering was produced by the excessive use of tobacco.

43. Many men, after having smoked three or four cigars or pipes in succession, within two or three hours for instance, have been afflicted with the so-called "double sight" or "double vision." By seeking the fresh air their normal sight has been restored, but in some cases not until the stomach has come to the rescue and, by ejecting the food which the excessive smoking has rendered it impossible for the stomach to digest, has made it possible for

the blood to flow unhindered through the blood-vessels, carrying with it the oxygen so necessary to the nerves of the eye, and which it must receive before this "double vision" can pass away.

44. The effect of alcohol is no less dangerous. Both tobacco and alcohol can produce this double vision. The sight is always more or less imperfect when alcohol is taken habitually and in large quantities. The hearing also is rendered less acute by the use of narcotics. The inaccuracy of sight and the indistinctness of hearing often go hand-in-hand when either tobacco or alcohol is used excessively.

QUESTIONS ON CHAPTER XIII

1. What is the relation of the brain to the special senses?
2. What parts of the body have no nerves?
3. What parts of the body have very little feeling?
4. Why do we not feel pain when under the influence of laughing-gas, ether, and chloroform?
5. How does pain protect the body?
6. What are the special senses?
7. What organs are furnished for them?
8. Where is the sense of touch most delicate?
9. What information is given to us by the sense of touch?
10. In what people is this sense often highly educated?
11. What are the characteristics of the blind?
12. Who was Dr. Samuel G. Howe?
13. What did Dr. Howe teach Laura Bridgman?
14. How did Dr. Howe teach her to do these things? Why?

15. What is said of Helen Kellar?
16. Is the sense of touch always correct?
17. What is the special organ of taste? What else possesses this faculty?
18. What motions has the tongue?
19. What causes the roughness of the tongue?
20. How are the nerves of the tongue useful to us?
21. What are our natural tastes?
22. How long does a child remain satisfied with a plain and wholesome diet?
23. What diet do natives of cold countries need? Can you tell why?
24. What is the chief use of the sense of taste?
25. To what is due the sense of smell?
26. Of what is the nose formed?
27. Why is the sense of smell destroyed when we have a cold?
28. What are the uses of the sense of smell?
29. What is sight?
30. What is one way in which sight is different from touch, taste, or smell?
31. What is the organ of sight? How is it protected?
32. To what part of the eye is the optic nerve joined?
33. What is the retina?
34. What is color-blindness?
35. What is the iris? What is the pupil?
36. When does the pupil grow larger? Smaller?
37. What is the cornea?
38. What causes near-sightedness? Far-sight?
39. What is the crystalline lens?
40. Is the picture of people, animals, and objects right side up or upside down in our eyes?
41. Why do we think they are in their correct positions?
42. Of what use are the eyebrows? The eyelids?
43. What are the uses of the eyelashes?

44. What is the lachrymal gland?
45. Of what use are the tears?
46. What and where is the nasal duct?
47. Mention several things to be avoided in the care of the eyes.
48. Where should the light be when we are reading or sewing?
49. What is sound?
50. What is hearing?
51. How is sound carried more distinctly, by solid substances or by the air?
52. What is necessary to sound?
53. What is the organ of hearing? What are the three parts of the ear?
54. Describe the outer ear.
55. What is the ear-drum?
56. What is the middle ear?
57. What is the tympanum?
58. What three bones are in the middle ear?
59. How does air get into the middle ear? Where is it?
60. What sometimes causes a partial loss of hearing?
61. What is the name of the inner ear?
62. In which ear are the nerves of hearing?
63. What things should be avoided if we wish our hearing to be good?
64. How can objects be easily removed from the ear?
65. Should anything cold, such as water, soap-suds, or oil, ever be put into the ear?
66. How do tobacco and alcohol affect the sense of touch?
67. How do they affect the sense of taste?
68. Is the sense of smell as keen after the lining of the nose has been injured by tobacco-smoke?
69. How does tobacco-smoke injure the lining of the nose?
70. What painful and fatal diseases does tobacco sometimes cause?

71. What has excessive smoking sometimes caused?

72. What other effect upon the sight has excessive smoking caused?

73. Can alcohol produce the same effect?

74. What two serious defects often accompany the excessive use of tobacco or alcohol?

CHAPTER XIV

IN CONCLUSION

1. While we do not claim that the care of the body is the most important subject of thought, we wish all the young people who study this book to feel that there are possibilities of usefulness and happiness that can only be realized when the body and mind are kept strong and well nourished. There is a strong feeling among many brave and true men and women that children and young people should be thoroughly well informed of the ill-effects of alcohol, tobacco, and other narcotics. The future glory of the country, the highest development of human life, and the nearest approach to moral strength and beauty are attained in avoiding the use of harmful and poisonous substances.

2. Alcohol, tobacco, and other narcotics do not strengthen, or nourish the body or any of its parts. Their ill-effects upon the body as a whole and upon its various parts and organs have been fully shown.

3. "The world is full of beauty when the heart is full of love." Has it occurred to you that your heart cannot be full of love when you knowingly do those things that may prove injurious to you, and in so doing destroy your own health and happiness and that of your parents, family, and friends? Again we are told:

> "How big the human heart! How much 'twill hold
> Of love! In it the blissful stream may pour
> Continually, and yet there's room for more."

Have you ever been too happy? Have you ever done too much for the happiness of others?

4. It is a simple matter to take good care of the body. It is a serious matter to take poor care of the body. In writing this book we have addressed ourselves directly to you; not to your older friends, your "grown-up" brothers and sisters, or your parents, but to you. Neither do we refer to their past nor to your past. We write to you now, asking *you* from *to-day* to follow the teachings of the truths contained in this book.

5. In the preceding chapter we spoke of the special senses. They are truly wonderful; but, after all, they are only parts of a still more wonderful whole. It is indeed wonderful to touch, to smell, to taste,

to see, and to hear, but it is infinitely more wonderful to think and to live. Would that the study of these things might make your thoughts sweeter and more helpful, and your lives more tender and true!

APPENDIX

Poisons and their Antidotes

ACCIDENTS from poisoning are of such frequent occurrence that every one should be able to administer the more common antidotes, until the *services of a physician can be obtained.* As many poisons bear a close resemblance to articles in common use, no dangerous substance should be brought into the household without having the word *poison* plainly written or printed on the label; and any package, box, or vial without a label, if the contents are not positively known, should be at once destroyed.

When a healthy person is taken severely and *suddenly* ill *soon after some substance has been swallowed*, we may suspect that he has been poisoned. In all cases where poison has been taken into the stomach, it should be quickly and thoroughly expelled by some active emetic, which can be speedily obtained. This may be accomplished by drinking a tumblerful of warm water containing either a tablespoonful of powdered mustard or of common salt, or two teaspoonfuls of powdered alum in two tablespoonfuls of syrup. When vomiting has already taken place, it should be maintained by copious draughts of warm water or mucilaginous drinks, such as gum-water or flaxseed tea, and tickling the throat with the finger until there is reason to believe that all the poisonous substance has been driven from the stomach.

The following list embraces only the more common poisons, together with such antidotes as are usually at hand, to be used until the physician arrives.

Acids.—*Hydrochloric acid; muriatic acid* (spirits of salt); ***nitric acid*** (aqua fortis); ***sulphuric acid*** (oil of vitriol).

ANTIDOTE.—An antidote should be given at once to neutralize the acid. Strong soapsuds is an efficient remedy, and can always be obtained. It should be followed by copious draughts of warm water or flaxseed tea. Chalk, magnesia, soda, or saleratus (with water) or lime-water are the best remedies. When sulphuric acid has been taken, water should be given sparingly, because when water unites with this acid intense heat is produced.

Oxalic acid.

ANTIDOTE.—Oxalic acid resembles Epsom salts in appearance, and may easily be mistaken for it. The antidotes are magnesia, or chalk mixed with water.

Prussic Acid.—*Oil of bitter almonds; laurel-water; cyanide of potassium* (used in electrotyping).

ANTIDOTE.—Cold douche to the spine. Chlorine-water, or water of ammonia largely diluted, should be given, and the vapor arising from them inhaled.

Alkalies and their Salts.—AMMONIA (hartshorn), *liquor or water of ammonia.* POTASSA:—*caustic potash, strong lye, carbonate of potassa* (pearlash), *nitrate of potassa* (saltpeter).

ANTIDOTE.—Give the vegetable acids diluted, as weak vinegar, acetic, citric, or tartaric acids dissolved in water. Castor oil, linseed oil, and sweet oil may also be used; they form soaps when mixed with the free alkalies, which they thus render harmless. The poisonous effects of saltpeter must be counteracted by taking mucilaginous drinks freely, so as to produce vomiting.

Alcohol.—*Brandy, wine; all spirituous liquors.*

ANTIDOTE.—Give as an emetic ground mustard or tartar emetic. If the patient cannot swallow, introduce a stomach-pump; pour cold water on the head.

Gases.—*Chlorine, carbonic-acid gas, carbonic oxide, fumes of burning charcoal, sulphuretted hydrogen, illuminating or coal gas.*

ANTIDOTE.—For poisoning by chlorine, inhale, cautiously, ammonia (hartshorn). For the other gases, cold water should be poured upon the head, and stimulants cautiously administered; artificial respiration. (See *Marshall Hall's Ready Method*, page 213.)

Metals.—*Antimony, tartar emetic, wine of antimony*, etc.

ANTIDOTE.—If vomiting has not occurred, it should be produced by

tickling the throat with the finger or a feather, and the abundant use of warm water. Astringent infusions, such as common tea, oak bark, and solution of tannin, act as antidotes.

Arsenic.—*White arsenic, Fowler's solution, fly-powder, cobalt, Paris green*, etc.

ANTIDOTE.—Produce vomiting at once with a tablespoonful or two of powdered mustard in a glass of warm water, or with ipecac. The antidote is hydrated peroxide of iron. If Fowler's solution has been taken, lime-water must be given.

Copper.—*Acetate of copper* (verdigris), *sulphate of copper* (blue vitriol), food cooked in dirty *copper vessels*, or pickles made green by *copper*.

ANTIDOTE.—Milk or white of eggs, with mucilaginous drinks (flaxseed tea, etc.), should be freely given.

Iron.—*Sulphate of iron* (copperas), etc.

ANTIDOTE.—Carbonate of soda in some mucilaginous drink, or in water, is an excellent antidote.

Lead.—*Acetate of lead* (sugar of lead), *carbonate of lead* (white lead), water kept in *leaden pipes* or *vessels*, food cooked in *vessels* glazed with *lead*.

ANTIDOTE.—Induce vomiting with ground mustard or common salt in warm water. The antidote for soluble preparations of lead is Epsom salts; for the insoluble forms, sulphuric acid largely diluted.

Mercury.—*Bichloride of mercury* (corrosive sublimate), *ammoniated mercury* (white precipitate), *red oxide of mercury* (red precipitate), *red sulphuret of mercury* (vermilion).

ANTIDOTE.—The white of eggs, or wheat flour beaten up with water and milk, are the best antidotes.

Silver.—*Nitrate of silver* (lunar caustic).

ANTIDOTE.—Give a teaspoonful of common salt in a tumbler of water. It decomposes the salts of silver and destroys their activity.

Zinc.—*Sulphate of zinc*, etc. (white vitriol).

ANTIDOTE.—The vomiting may be relieved by copious draughts of warm water. The antidote is carbonate of soda administered in water.

Narcotic Poisons.—*Opium* (laudanum, paregoric, salts of morphia, Godfrey's cordial, Dalby's carminative, soothing syrup, cholera mixt-

ures), *aconite, belladonna, hemlock, stramonium, digitalis, tobacco, hyoscyamus, nux vomica, strychnine.*

ANTIDOTE.—Empty the stomach by the most active emetics, as mustard, alum, or sulphate of zinc. The patient should be kept in motion, and cold water dashed on the head and shoulders. Strong coffee must be given. The physician will use the stomach-pump and electricity. In poisoning by nux vomica or strychnine, etc., chloroform or ether should be inhaled to quiet the spasms.

Irritant Vegetable Poisons.—*Croton oil, oil of savine, poke, oil of tansy,* etc.

ANTIDOTE.—If vomiting has taken place, it may be rendered easier by copious draughts of warm water. But if symptoms of insensibility have come on without vomiting, it ought to be immediately excited by ground mustard mixed with warm water, or some other active emetic, and after its operation an active purgative should be given. After expelling as much of the poison as possible, strong coffee or vinegar and water may be given with advantage.

Poisonous Fish.—*Conger eel, mussels, crabs,* etc.

ANTIDOTE.—Evacuate, as soon as possible, the contents of the stomach and bowels by emetics (ground mustard mixed with warm water or powdered alum) and castor oil, drinking freely at the same time of vinegar and water. Ether, with a few drops of laudanum mixed with sugar and water, may afterward be taken freely.

Poisonous Serpents.—ANTIDOTE.—A ligature or handkerchief should be applied moderately tight above the bite, and a cupping-glass over the wound. The patient should drink freely of alcoholic stimulants containing a small quantity of ammonia. The physician may inject ammonia into the veins.

Poisonous Insects.—*Stings of scorpion, hornet, wasp, bee,* etc.

ANTIDOTE.—A piece of rag moistened with a solution of carbolic acid may be kept on the affected part until the pain is relieved; and a few drops of carbolic acid may be given frequently in a little water. The sting may be removed by making strong pressure around it with the barrel of a small watch key.

Drowning

MARSHALL HALL'S "READY METHOD" of treatment in asphyxia from drowning, chloroform, coal-gas, etc.

1st. Treat the patient *instantly on the spot*, in the *open air*, freely exposing the face, neck, and chest to the breeze, except in severe weather.

2d. In order *to clear the throat*, place the patient gently on the face, with one wrist under the forehead, that all fluid, and the tongue itself, may fall forward, and leave the entrance into the windpipe free.

3d. *To excite respiration*, turn the patient slightly on his side, and apply some irritating or stimulating agent to the nostrils, as *veratrine*, *dilute ammonia*, etc.

4th. Make the face warm by brisk friction; then dash cold water upon it.

5th. If not successful, lose no time; but, *to imitate respiration*, place the patient on his face, and turn the body gently, but completely, *on the side, and a little beyond;* then again on the face, and so on, alternately. Repeat these movements deliberately and perseveringly, *fifteen times only* in a minute. (When the patient lies on the thorax, this cavity is *compressed* by the weight of the body, and *ex*piration takes place. When he is turned on the side, this pressure is removed, and *in*spiration occurs.)

6th. When the prone position is resumed, make a uniform and efficient pressure *along the spine*, removing the pressure immediately, before rotation on the side. (The pressure augments the *ex*piration; the rotation commences *in*spiration.) Continue these measures.

7th. Rub the limbs *upward*, with *firm pressure* and with *energy*. (The object being to aid the return of venous blood to the heart.)

8th. Substitute for the patient's wet clothing, if possible, such other covering as can be instantly procured, each bystander supplying a coat or cloak, etc. Meantime, and from time to time, *to excite inspiration*, let the surface of the body be *slapped* briskly with the hand.

9th. Rub the body briskly till it is dry and warm, then dash *cold* water upon it, and repeat the rubbing.

Avoid the immediate removal of the patient, as it involves a *dangerous loss of time;* also, the use of bellows, or any *forcing* instrument; also, the *warm bath*, and *all rough treatment*.

The Care of the Sick-room

The sick-room should be bright and airy, and "Sweetness and light" its motto. Other things being equal, it is best on one of the

upper floors—in the case of some "catching" disease, on the top floor. Let it be on the sunny side of the house. If for any reason the light of the sun is temporarily to be avoided—as when the eyes are sensitive or have been operated upon—let the light be shut out by a proper arrangement of blinds or curtains. The air-supply to be breathed by the sick person should be pure. To keep the air pure, the room should be aired three times a day, care being taken to protect the patient from chill.

Unless the physician direct differently, one window—that most remote from the bed—should be open an inch or more both day and night, and in all seasons.

A fire in an open fireplace, except in summer weather, will be a great help towards keeping the air pure.

Take special care that no stationary wash basin or other sewer-connected convenience is improperly plumbed, and that sewer-gas cannot by any possibility escape into the sick-room.

The swinging of doors to create a current is not an efficient means of ventilation, as it agitates the air of the room without purifying it, and often disturbs the patient.

It should be borne in mind that cold air is not necessarily pure air, and that ventilation is not less needed in winter than in warm weather. The temperature of the room should not be allowed to vary much from 65° F., unless the doctor otherwise directs.

Sleep is a great necessity to the sick. If a well person slumbers in the daytime, it will interfere with his sound repose at night, but with the sick this is generally not the case. The more they sleep the more favorable are the chances for their recovery: so that it will be readily seen how important it is to avoid noise and jar in the sick-room, especially if the disease is acute. Bear in mind that even slight noises, as the rustling of garments, the creaking of doors, whispering or noisy footfalls, may be sufficient to disturb a brain that is rendered sensitive by pain or wakefulness.

The clothing next the skin should be changed more frequently in sickness than in health. These changes must be quickly and deftly made, and with as little disturbance as possible.

Under some conditions of disease, the best welfare of the patient is accomplished by having two beds in the room instead of one.

Let the furniture be as plain and as free from upholstery as possible: not many pieces are required. Movable carpets or rugs are better than those that are permanently laid. Curtains about the windows are out of place in a sick-room: so are flowering plants and birds, as a general rule. Florence Nightingale, however, makes an exception in the case of chronic invalids, and consents to the comforting influence of a pet bird or two.

In regard to the admission of visitors and conversation, much will depend upon the strength of the patient and the kind of sickness: at many times these are to be forbidden, as having a disquieting influence. When contagious disease is in the house, the sick-room must be avoided by all except those who have the care of the patient, and those having this care should avoid coming in contact with the other members of the household, especially the children.

Bear in mind that everything brought in contact with the sick is liable to endanger the health of the well.

No articles in use by the invalid should be removed or used by others until thoroughly disinfected: the dishes and spoons should be put in boiling water before being taken from the room. The room itself should be fumigated with sulphur when the person is removed from it.

Old pieces of muslin, etc., may be used instead of handkerchiefs to receive the poisonous discharges from the nose, mouth, and throat. These can be destroyed by fire, and thus prevent the danger of conveying the disease to others.

"Taking the breath" and kissing should be avoided by those in attendance upon the case.

The bottles of medicine and other reminders of illness should, as far as convenient, be withdrawn from the view of the sick.

Such as are to be kept always at hand should be arranged in an orderly way upon a tidily-covered bedside table. The sight of a siphon-bottle of aërated water is agreeable to most patients; that may be kept in the room, but the vessels containing milk, drinking-water, etc., should be kept elsewhere.

Disinfection

Filth fosters or produces certain diseases; it should therefore be removed as soon as possible. When it is difficult to remove it, disin-

fectants come into play, as they have the power to rob it of some of its disease-making force. But let it be remembered that disinfection is not cure: it is not a substitute for cleanliness and pure air. The true cure is the removal of filth; and when our homes are concerned in some question of drainage where the filth is out of our sight, it may be necessary to consult and employ the plumber or some other artisan.

It must be borne in mind that the great preventive of disease is cleanliness both of person and of surroundings, and that no deodorizer or disinfectant will take the place of soap and the scrubbing-brush. Only when, for some reason, filth cannot be removed at once disinfectants may be used to prevent disease. Among the better known of these are carbolic acid and chloride of lime. A cheap disinfectant is made by dissolving half a drachm of nitrate of lead in a pint or more of boiling water. Then dissolve two drachms of common salt in a bucket of water; pour the two solutions together and allow the sediment to sink. A cloth dipped in this and hung up in a room will correct a bad odor promptly, or if the solution be thrown down a drain or upon foul-smelling refuse it will have the same effect.

The room to be purified with sulphur should be made as tight as possible, so that no fumes can escape either by window, door, or chimney. Put three pounds of sulphur in an iron pot, which should not stand upon woodwork or carpet, lest they be burned, but in a large pan of ashes, or upon a layer of bricks; on this sulphur pour a tablespoonful of alcohol. This is then set on fire, and everybody immediately withdraws from the room. The room should remain closed ten hours, after which it should be thoroughly aired before it is occupied, for the fumes of the sulphur are irritating to the lungs.

The chemicals above mentioned should be known and labeled as poisons. Many persons have been injured, if not killed, by incautiously or ignorantly drinking those that are of a liquid form.

Certain diseases are "catching"; they have the power of spreading from one person to another, chiefly by the particles that pass off from the body of the patient. Among these diseases are smallpox, measles, scarlet fever, and diphtheria. The articles that are worn or used by the patient become "infected," and they should be disinfected before they are used by others. As a rule, of course, a doctor will be called in to attend to these diseases. When that is so, follow his directions

as to disinfection as well as every other part of the treatment of the case. For substances that are not injured by being washed, a good and cheap disinfectant is sulphate of zinc ("white vitriol") and common salt dissolved in water, boiling-hot if possible: using eight tablespoonfuls of the zinc and four of salt to the gallon of water. This is useful for clothing, bed-linen, towels, handkerchiefs, etc. After these articles have lain for an hour or two in this solution, they should be allowed to stand in boiling water before being washed. Infected articles that are of little value should, of course, be destroyed by fire.

Emergencies

The life of many a child has been saved by the fire-drill in schools, and great good has been done on shipboard by a drilling of the crews.

If in a building filled with smoke, get down on hands and knees and crawl to door or window.

In a cellar, well, or vat where carbonic acid can collect, the true posture is to stand erect. If a candle, on being lowered into a suspected place, is put out, you may know that there is danger to human life.

Burns and Scalds.—The secret of the best treatment of these injuries is to exclude the air from the wounded surfaces. When they are slight, and the skin is not destroyed but merely blistered, prevent the displacement of the skin as much as possible. Let the blisters be punctured, if necessary, to let out the liquid, and then keep the skin in place by cotton cloth or lint, wet with a solution of one teaspoonful of carbolic acid in a quart of water, or a strong solution of baking-soda. The cloth should be kept wet constantly, but do not irritate the wound by taking off the dressing too often.

Extensive burns are much worse than deep burns. In the former case, the outlook is grave and the patient will probably require the best aid, both medical and surgical, of some physician.

Scars after Burns.—If a burn be on the face, neck, or near a joint, it is not well to hasten the healing process, on account of the contraction that always takes place as the scar is formed.

When a woman's clothes are on fire she should not be allowed to run, but should be rolled up in the nearest woolen article, rug, blanket, or coat.

Illuminating Gas is dangerous in two ways. If it escapes into a

tightly closed room in sufficient quantities, it causes the death of the inmates by suffocation, unless some one from without discovers the perilous situation. If not too late, remove the patient into fresh air, undo the clothing, dash cold water on the face and neck, and employ artificial respiration, as in drowning (see p. 213). Again: If it escapes freely into an apartment, it forms an explosive compound by mixing with the air. If then a light is unguardedly taken into the place, an explosion that may be destructive to life will result. Always thoroughly air any room that has the odor of escaping gas before a light is taken in.

Kerosene is the cause of even more "accidents" than gas. Too much care cannot be taken in its use. Buy only that which has been tested, but remember that not all that are marked as "safe" are truly so. If a responsible oil-man certifies that the oil will not "flash" under 140°, it may be regarded as safe if properly used. Lamps should be filled only in the daytime. Never attempt to fill a lamp that is lighted, and never put kerosene in the stove for the purpose of kindling a fire. Very small lamps are dangerous, as also is a lamp that has burned a long time and has but very little oil in it.

Frost-bites.—Keep away from the fire and in a cool room. Rub the nose or other part that has been "bitten" with snow or ice-water until the blood is again warmed and circulating in the part. Chilblains should not be brought to the fire; if the skin is unbroken, it should be hardened by brushing it over with alcohol having tannin in it.

Cuts.—These, if severe, should be promptly attended by a physician, but every one should know how to treat small wounds. Learn the difference between the two kinds of bleeding, called "arterial" and "venous." Arterial is bright red and comes in jets (or with throbs corresponding to the pulse); venous is dark colored and flows continuously. In the former, press on that side of the wound nearer to the heart; in the latter, on the further side. Or, pressure may be made over the wound itself with the fingers; this may stop the loss of blood from small arteries as well as from veins. Loss of blood from arteries is apt to be more rapid and dangerous than that from veins, and when the cut vessel is a large one, the skill of the surgeon will ordinarily be required in order to close the bleeding artery permanently and securely.

It is well, in every household, to have, in some handy and well-known place, some strips of old muslin and some lint or oakum, a bandage or two and some adhesive plaster, a soft sponge, and needles and thread in a basket or box by themselves. In this way valuable time may be saved in the stanching of blood flowing in consequence of some accidental cut or other injury.

Fits or Convulsions.—These may be trivial or grave. If it is a young woman, the attack is probably hysterical and, as a rule, not dangerous, and a sprinkle of cold water will bring relief. If the patient struggles with regularity of movement, and there is bloody froth on the lips, it is a case of epilepsy, and requires a physician's attendance. Meanwhile, protect the head from injury by putting a pillow or some soft article beneath it; a cork introduced between the teeth will prevent the biting of the tongue. Prevent the person from falling or injuring himself, but do not attempt to forcibly hold him quiet.

In children, apply cloths dipped in water to the head; disturb the child as little as possible; do not use a warm bath until directed by the doctor.

Fainting.—This occurs when the blood is deficient in the brain. The proper position, therefore, is upon the back. Let the window be opened to admit fresh air; fanning and the sprinkling of water are useful. If the clothing about the chest is tight, let it be loosened. If the faint occurs at church or some public gathering, remove the person promptly to the outer air: for foul air is frequently the cause of the trouble.

Vertigo.—This is "a rush of blood to the brain." The body should be placed in the sitting posture, with the head erect. If the blood escapes into the brain by reason of the rupture of a blood-vessel within it, the case is very grave, and the physician should be summoned at once. Meanwhile, let the position of the body be as above stated. Apoplexy is known, in very many cases, by the helpless condition of an arm or leg, or both.

Sunstroke is seldom produced in this climate in persons who have not labored too hard. Fatigue and sun-heat are commonly the joint causes of sudden prostration in summer; although "heat-stroke" may occur in an artificially heated atmosphere, without exposure to the sun. In the tropics, the least possible exertion is put forth by the

natives during the midday hours. On very hot days, therefore, avoid fatigue and labor in the open air as much as possible. Keep the head cool. If any unusual, dizzy feeling comes on, apply cold water to the head and neck. If a person falls unconscious and the skin is decidedly hot and dry, he should be taken to a cool place. If the face and head are red and hot, apply ice-water on cloths. If pale, give stimulants gradually and use cold water sparingly.

Shock may be caused by a fall or a blow upon the head or the pit of the stomach. It is known by slowing of the pulse and respiration; the face is pale and the skin becomes cool. The head should be placed low, some ammonia in water be given, and warmth applied to the surface of the body.

The Home and Health

The location of the house should be airy, dry, and sunny.

A certain amount of elevation is necessary in order to secure proper drainage. Too much shade must not fall upon the house, as sunlight is very necessary to a proper degree of animal vigor. Young children, as is well known, especially profit by the tonic influence of sunlight.

The cellar is an important part of the dwelling; therefore, unless care be taken for its ample ventilation, it will be the source from which is supplied much of the air breathed in the upper chambers of the house. If the cellar is damp the house is liable to become so, and if vegetables are stored in the cellar, an especial degree of care is needed to ventilate it thoroughly and constantly.

House-drainage.—An English writer has stated that "the most important part of the house is the drains." This, no doubt, sounds strangely to the ears of many, who have been brought up to view the parlor or drawing-room as the true center of the house, and yet it is no foolish saying, when we reflect that with a bad system of drainage to a house every dweller therein stands in peril of several forms of disease that, mild as the cases may be, are a source of anxiety and, when severe, too often have a fatal termination. Drain-diseases, such as typhoid fever, dysentery, diphtheria, and scarlet fever, often destroy entire families. These diseases do not always spring upon a home through defective drainage, but when they do they frequently show themselves in a very violent form.

Drainage (as applied to dwellings) consists in conveying away from

the house the liquid and solid impurities that would otherwise accumulate in or near the dwelling. Waste is a necessary accompaniment of all animal life, to the preparation and the taking of food, to the clothing of the body, to bathing and other simple acts of daily life. The waste material of houses tends to decay and to become offensive. It must, therefore, not only be put out of sight and smell, but must be removed so far away that it cannot return in the form of dangerous, invisible gases of decomposition.

The best house-drains are made of iron or glazed earthenware, carefully selected and well laid. The joints of the pipes should be gas-tight. The soil-pipe should be carried up to and through the roof. All the waste-pipes from basins, etc., in the rooms should be joined in a gas-tight manner to the soil-pipe, and each and every basin and other fixture should have a separate trap. What is a trap? It is a device that is designed to retain a certain portion of the water running through it—called the "water-seal"—so that the ascent of air or gas, from the drain back into the room, is prevented. It "traps" the sewer-gas away from us. Whenever a fixture has been used and there is not, beyond all doubt, a sufficiency of water to fill the trap, additional water should be poured in. Traps are of various sizes and of an infinite variety of patterns and patents, and must vary greatly according to their situation; but one thing should be made sure of in their use, namely, that they hold not less than two inches of water as a "seal."

There is at almost all seasons of the year an upward, because warmer, current of air through the main pipes. It is therefore better to have a fresh-air inlet pipe near the point where the drain leaves the house-wall. This helps to prevent the unsealing of traps. It also brings about a purer condition of the air in the interior of the system of pipes: so useful is this air-current through the soil-pipe that if applied there is little danger of the escape of sewer-gas into the living-rooms.

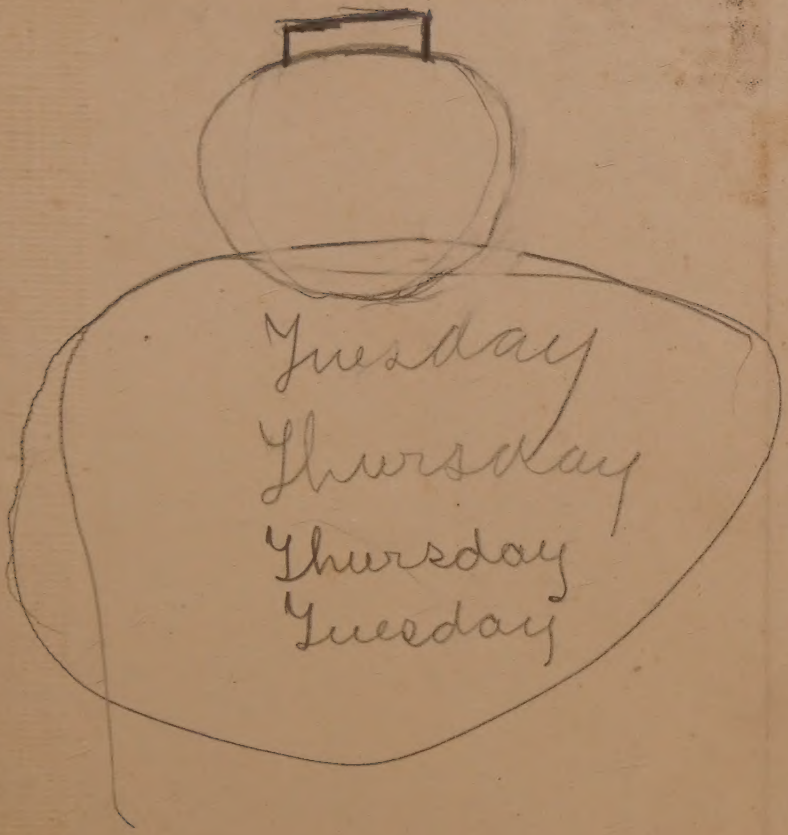
What is sewer-gas or sewer-air? It varies greatly in different places and at different times. It is not a definite gas, like oxygen, nitrogen, etc., but varies in composition, and what is still more worthy of note, it varies in its dangerous qualities. It is not always offensive, although it is generally so; its odor has been described as being "sweetish and sickish." Its dangerous qualities have not yet been determined by

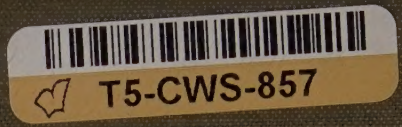
chemistry or the microscope, but one practical point may be borne in mind, namely, that when a case or cases of contagious disease occur in any house along any given line of sewer-pipes, it is best to use disinfectants in the drainage of the other dwellings along the same line of sewer. Children should avoid playing over or around the sewer-gratings in the streets at all times, and especially when scarlet fever and like contagious diseases are known to be in the neighborhood, for the exit of sewer-air at these points is always very free, unless it be directly after a rainfall.

One other point must be remembered, that the best-laid system of house plumbing is not indestructible. In the course of time defects will arise, breaks will occur; for this reason it would be well for every householder to have an examination made at intervals of every joint and along the whole line of the house connection with the sewer or drain.

It is thought by many that sewer-gas is not found in the country because there are no sewers: they have been misled by the word. If the words "drain-air" or "filth-gas" had been adopted, the universal production of this injurious substance, in close connection with every abode of man, wherever located, might have been better understood. In country houses there are, perhaps, fewer dangers of contamination of the air we breathe by waste products, because there are fewer water-closets, wash-basins, sinks, etc., and the rooms are less exposed to impure air.

Drainage in the city is a comparatively easy problem when the city's sewers are laid in the streets. In the country it is more difficult, and on this account the fewer fixtures or "modern improvements" there are in the house the better it will be. There should be no less care within the country house, where wastes-pipes are put in, than in the city house. The material should be well selected, tightly joined, and properly ventilated. The water-closet should be remote from the house. Earth closets are better than the ordinary vaults. House-waste from kitchen and laundry should be taken to a considerable distance from the house, and far away from the well, and either deposited in a water-tight cesspool or conveyed away, by a system of subsoil drainage-tiles, arranged so as to fertilize some unoccupied plot of ground.


Tuesday
Thursday
Thursday
Tuesday


T5-CWS-857